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Threatened non-marine molluscs of Europe

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Threatened non-marine molluscs of Europe

by **Susan M. Wells** and **June E. Chatfield**

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PREFACE

The basis of this report is data collected in 1983 at the IUCN Conservation Monitoring Centre (now the World Conservation Monitoring Centre). This information has been updated through correspondence and review of recent literature. Important sources have been the atlases produced by, and biological recording schemes underway in, several countries, national Red Data Books and threatened species lists, scientific publications and perhaps most importantly the knowledge of numerous local experts.

Some of the report may appear rather fragmentary. This in part reflects the nature of the data available, as discussed in the introduction, but is also due to over-optimism on the part of the authors as to the amount of data that could be analysed and synthesised in the course of a six-month grant. The information that was gathered has been deposited with the World Conservation Monitoring Centre and hopefully will provide the basis for further work.

Detailed country tables, listing threatened non-marine molluscs at the national level, were compiled in the course of the project in order to identify both narrow endemics at risk and the more widespread species that are declining throughout their range. This report contains data sheets for the species considered most at risk, including all species listed on the Bern Convention. It has not been possible to publish the country tables with the report, but they will be made available separately. It is suggested that enquiries about these are directed to the authors or to the World Conservation Monitoring Centre in Cambridge.

The entire report, and/or individual sections and data sheets have been reviewed by many malacologists in Europe, and we apologise if we have failed to contact any other important sources. Certain groups have not been reviewed as thoroughly as we would have wished (notably the Hydrobiidae and Sphaeriidae); we would like to stress that this was because we were unable to carry out the necessary correspondence in the time available rather than any failure on the part of relevant experts to provide information.

The major political changes that have taken place within Europe during the project have also contributed to the difficulties in synthesising the material. The designation of geographical entities in the report do not imply the expression of any opinion whatsoever on the part of the organisations involved in its publication concerning the delimitation of frontiers or the legal status of any country.

We apologise for the lack of accents in the text; this was due to lack of time at the production stage. For the same reason, we have been unable to fully check the taxonomy used, and are aware that this is not consistent throughout the report. There are widely differing views on the taxonomy of some groups of European non-marine molluscs and to produce an acceptable system would be a massive undertaking. We have tended to adopt whatever is most widely used.

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SUMMARY

Documentation of non-marine mollusc distribution and conservation has accelerated over the last decade in Northern Europ with the production of national Red Data Books and as a result of mapping programmes and biological recording schemes. The information indicates that many species are now of conservation concern.

For the purpose of the report, three groups of molluscs have been identified: national (country, territory or island) endemics, 'near' endemics (or species restricted to narrow geographical ranges) and species that are widespread but declining throughout much of their range.

Information, as for other invertebrate groups, is more complete for the northern countries which have lowest endemism and species diversity. Habitat change in this region has been extensive in the past but current rates of change are possibly slower than in the south. This suggests that it is the poorly documented southern faunas, with highest endemism and diversity, that may be at greatest risk and yet this is most difficult to quantify. Some 200 endemic non-marine molluscs have been identified in Europe as of conservation concern and are listed with IUCN categories of threat. Many of these are on the Mediterranean and Atlantic islands, emphasising the fragility of island faunas in the face of development pressures such as tourism, modern agricultural methods and industry. Other endemics have also been listed even where information was unavailable on their status, in the hope that this will encourage further work on these groups. For example, the ancient lakes of Baikal and Ohrid have extraordinarily high molluscan endemism, and many species may be at risk from pollution although information is not available at present.

A number of 'near' endemics are identified as threatened. Some of these are equivalent to national endemics in having very restricted ranges, the fact that they occur in more than one country simply being a result of political boundaries. Others are restricted to a single river system, such as the Danube, or to a particular geographical/climatic region, such as the Atlantic coastal area of Europe. Of the 27 widespread but declining species identified, the majority are wetland or freshwater inhabitants. The unionids, or freshwater pearl mussels are perhaps most seriously at risk.

The main threats to all non-marine molluscs are loss of habitat and, for freshwater species, pollution. Few if any species are threatened by collecting, but for the popular edible species, such as Helix pomatia, and narrow endemics that are of interest to shell collectors such as the Madeiran species, exploitation should continue to be monitored.

Molluscs, with other invertebrates, are starting to be considered in conservation initiatives. Twenty three molluscs are listed on the Bern Convention and a number have been proposed for the EEC Habitats Directive. At the national level, molluscs are still very rarely taken into consideration in the planning and management of nature reserves although this is starting to change, but they are included in numerous national Red Data Books and certain species, such as the freshwater pearl mussel, are the subject of major conservation programmes.

The report concludes with recommendations for improved protection and management of non-marine molluscs in Europe, including better representation of threatened molluscs on treaties and red lists, improved habitat management taking molluscan requirements into consideration, the creation of new protected areas, as well as further taxonomic and basic ecological resarch..

INTRODUCTION

After the arthropods, molluscs are the most diverse animal group in the world with an estimated 150,000 species. Large numbers of species are yet to be described, but Solem (1984) suggests that the world total of land snails may be between 30,000 and 35,000 species. A similar estimate for freshwater molluscs has yet to be made. The European non-marine mollusc fauna has been estimated at around 1500 species (Pfleger and Chatfield, 1988), although this figure could be altered substantially as further taxonomic work is carried out.

The last decade has seen a rapid increase in knowledge of the European fauna, and numerous taxonomic revisions and major studies are underway. However this period has seen an equivalent growth in threats to natural habitats and wildlife in almost every part of the region. As with other invertebrate groups, there is now clearly a race between the scientists collecting often very basic information about animals, and the impacts that may lead to their extinction. A significant number of recent taxonomic papers describing new mollusc species comment on their rarity and conservation status.

Fortunately, the last decade has also seen a growing interest in invertebrate conservation. Recent publications include several Council of Europe reports on invertebrates (e.g. Collins and Wells, 1987), the Charter for Invertebrates (Pavan, 1986), and numerous national Red Data Books and lists (see Table 2 for those listing molluscs). Furthermore, there is now widespread acceptance that invertebrates should be taken account of in international treaties and legislation such as the Bern Convention, the Ramsar Convention and EEC Habitats Directive, and that their requirements should be considered in conservation programmes and management plans.

Background

In 1983, a resolution was passed at the 8th International Malacological Congress in Budapest calling for the compilation of a report on the conservation status of molluscs in Europe. Following this, work was started at the then IUCN Conservation Monitoring Centre, in Cambridge (now the World Conservation Monitoring Centre, WCMC). The data collected at that time formed the basis for the section on molluscs in the Council of Europe report on 'Invertebrates in need of Special Protection in Europe' (Collins and Wells, 1987), and the subsequent listing of 23 mollusc species on the Bern Convention. However, it was always recognised that this information constituted a very preliminary overview of the situation.

This new report is also in many ways a preliminary review, but for different reasons. Information on non-marine molluscs is still very scanty for many parts of Europe and it is impossible to determine the conservation status of many species. The taxonomic work that is underway means that species names are in considerable fluctuation and much debated. Many early species descriptions were based on shell characteristics alone, and recent work on the soft parts of the animals often prove these inaccurate. However, as this report shows, if we are to wait until all taxonomic problems have been resolved and all the necessary data gathered, we run the risk that many species will be on the verge of extinction if not extinct already. It is often not essential to understand the precise taxonomy. In Malta, for example, the threatened endemic taxa of snails are of concern whether they are species, subspecies or populations. Their conservation will ensure that their habitats, important for other wildlife and as part of the natural heritage of these islands, are preserved and that the snails themselves continue to provide the scientific material that is proving so valuable in more general and far reaching research into the biogeography of the Mediterranean. In the Pacific, this opportunity has now been lost on

at least one island (Moorea in French Polynesia), where the endemic Partula snails, which have been the subject of several decades of genetic research, became extinct in the 1980s (Murray et al., 1988); it is feared that extinctions may be occurring on many other islands. It is hoped that this report will go some way to stalling such events occurring in the European context.

Area covered

The report considers Europe in a fairly broad sense. Most of the species covered are Western Palearctic, a region that includes the countries of the Eastern Mediterranean as far as south-west Asia, Africa north of the Sahara as well as the north-east Atlantic islands. We have covered most of this area, with the obvious exception of north Africa. The boundary of the European part of the USSR is generally considered to be the eastern Urals, Ural River, Caspian Sea, Kuma and Manych Rivers. It will therefore seem an anomaly to have included Lake Baikal, but it was felt that this is of such malacological importance that attention should be drawn to it.

Table 1 gives estimates of the number of species found in each country, with figures for endemism and threatened species where available. Strictly brackish-water species have been excluded (although many are under serious threat through loss of their coastal habitat) but it is often difficult to make a precise distinction between freshwater and marine species; gastropods in particular are often found in coastal waters of all salinities.

As with other taxonomic groups, knowledge of molluscs is not uniform throughout Europe. Many faunas are almost as poorly known as some of those in tropical and more scientifically remote parts of the world. Ironically the areas with highest species diversity tend to lie in those countries with least resources for malacological research. Despite their rich faunas, information for many Mediterranean countries is still very poor, and this report is far from complete for these, particularly for Spain, Italy, Yugoslavia, and Greece. Portugal and Albania have smaller faunas but are equally little known. Turkey and Cyprus are poorly covered; there is some information on endemic species in Cyprus, and Gittenberger and Menkhorst (1991) recently reviewed the nine species of the genus Bulimulinus (Enidae) found in Turkey, three of which are newly described and may be endemic. The northern European countries, with much lower species diversity and endemism, are much better known, and have had the added advantage in several cases of dedicated amateur malacologists who have collected information on species distributions over many years (although we were unable to collect data on Luxembourg). The fauna of Eastern Europe is fairly well known, but language problems and the time available for compilation of this report has prevented a full review of the literature.

Distribution of molluscs in Europe

The majority of the European non-marine mollusc fauna is Palearctic and species are found in part of or throughout Europe, North Africa, Eurasia. A few, such as Margaritifera margaritifera, extend into North America, and have a Holarctic distribtution. Others have become established in North America, probably as introductions with plants. Distinct faunal groupings are found in Central Europe (species adapted to a continental-type climate), Western Europe or Atlantic (adapted to a warm damp climate), Southern Europe, which is particularly distinctive with species restricted to the Mediterranean region and islands and adapted to hot dry summers and warm wet winters, and the mountain faunas of the Alps, Carpathians, Balkans and Pyrenees.

Table 1. NON-MARINE MOLLUSCS BY COUNTRY

N.B. Most of these figures are approximations. Totals for 'threatened' species are taken either from national red data books and lists or from the information supplied for the country tables that were used to compile this report (these sometimes do not correspond exactly with official listings). All species in the categories listed in the threat section of this report have been included in the totals for 'threatened' (including the category Rare and Of Special Concern).

country	total no. spp	no./% threatened	no./% endemic
Andorra[q]	c. 38	?	0
Austria[k]	328	168/51%	25/7/6%
Azores[a]	98*	12+/12%+	41*/41.8%
Balearic Is	?	?	?
Belgium[c]	199	c 50/c.25%	0
Bulgaria	?	?	?
Canary Is[a]	181*	31+/17%+	141*/77.9%
Cape Verde Is[a]	37*	?	16*/43.2%
Corsica[l]	c 90	7+/7%+	c 8/9%
Czechoslovakia[j]	243?	c 53/c.22%	7*/c.2%
Denmark	?	31	0
Finland[e]	148	23/16%	0
France[f]	c 400	c 50/c.12%	c 70
Germany[n]	301	145/48%	11/c.3.5%
Gibraltar	38	c 14/c 37%	3/c 8%
Great Britain[h]	c 190	c 25-37/13-19%	0
Greece[d]	?	?	?
Cyclades	82		29+/35%
Hungary[s]	221	67/30%	1/.5%??
Iceland	?	8	0
Ireland	150	41/27%	0
Italy	400+	?	?
Luxembourg	?	?	0
Madeira[b]	237	60-80/25-30%	171*/88%
Malta[g]	c. 65	c.22/c.33%	c. 7/c.10%
Netherlands	104+	78/75%	0
Norway[p]	134	42/31%	0
Poland	?	111	?
Portugal	?	?	?
Romania[m]	378	?	145/37%
Salvage Is[r]	1	?	1/100%
Sardinia	?	?	?
Spain	?	?	?
Sweden[b]	113?/93	39/c. 42%	0
Switzerland	264	113/43%	5?
Yugoslavia	?	?	?
USSR[i]	c 778?	23+/3%+	288/c 37%

* = including subspecies
+ = minimum number

a = Walden (1984 a and b)
b = Walden (in press), Walden (1984b)
c = van Goethem (1989)
d = Mylonas (in litt., 1990); Mylonas (1982)
e = Valovirta (in litt., 31.5.91) = figures from new Red Data Book
f = Bouchet (1990)
g = Thake and Schembri (1989), Beckmann (1987), Beckmann (in prep.)

h = Bratton (1991)
i = Bannikov & Solakov (1984), Likharev & Rammel'meir (1962), Zhadin (1965)
j = Steffek (1989, and in litt., 1990)
k = Reischutz (in litt., 23.2.91)
l = Real Testud (1988); see also Holyoak (1983) for slightly different figures
m = Grossu (1984)
n = Bless in litt. 15.3.91; further information available in Jungbluth & Groh (1987)
p = Kuiper et al. (1989); Okland (1990); Okland and Anderson (1984); Walden (1984c) N.B. the majority of threatened species have the category rare and are on the edge of their range
q = Aguilar-amat (1935)
r = Gittenberger & Ripken (1987), Walden (1984b)
s = Pinter et al. (1979)

North of the Alps, the molluscan fauna is less diverse with many fewer endemics, and it is relatively homogenous. To the south, much higher diversities and levels of endemism are found. Increasing diversity towards the south is very noticeable; for example, in Germany, about 180 species are found in Schleswig-Holstein but over 280 in Bavaria (Jungbluth in litt., 15.4.91). Many narrow endemics are found in the mountain regions of the Alps, Carpathians, Balkans and Pyrenees, and on the islands of the Mediterranean and east Atlantic. A number of European molluscs are termed relict species. These have the appearance of being narrow endemics, but in colder times were much more widely distributed. They are now restricted to high altitudes of northern Europe.

Many molluscs have been introduced accidentally or intentionally outside their natural range. Recent accidental introductions have been excluded from this report, but some long-established introductions, now found only in natural or ancient man-made habitats with low intensity agriculture are included. An example is Helix pomatia, introduced into Britain in Roman times. This policy has been used in several national studies on threatened molluscs, e.g. the British Red Data Book (Bratton, 1991) and the Finnish Red Data Book (Rassi and Vaisanen, 1987).

Some mollusc species in Europe are undergoing fairly rapid expansions of their ranges. Mapping schemes are revealing this to be the case with, for example, Deroceras caruanae and Boettgerilla pallens in Belgium (van Goethem et al., 1987). These are usually small species, that can live in association with man or are well adapted to disturbed habitats associated with human activity, and that are easily transported with plants.

Scientific, economic and ecological importance of molluscs

Molluscs play important roles in food chains and mineral cycling, providing food for a variety of other animals, particularly birds and some insects and mammals. Many are detritivores and are involved in the breakdown of organic materials, and a few may play a role in plant dispersal.

The molluscan species assemblage of a habitat can sometimes provide a good indicator of environmental quality. Certain communities provide good indicators of ancient grasslands, woodlands and marshes and undisturbed waterways because of their sensitivity to disturbance (Kerney and Stubbs, 1980). These communities are often in association with scarce plants, vertebrates and other invertebrates and are indicative of sites worth protecting (Bratton, 1991).

Some molluscs provide a sensitive tool for monitoring habitat quality. Mapping of sphaeriids and freshwater snails in Norway has shown that these species are dependent on the pH values in lakes and may accordingly be used as biological indicators of acid rain (Okland and Kuiper, 1980, 1982; Okland and Okland, 1981, 1989; Okland, 1990). Molluscs, like some other invertebrates, may respond rapidly to only slight changes in conditions, such as shading and water level, before effects on vegetation are visible. They may therefore provide an early warning of chronic habitat deterioration. Freshwater mussels are generally good indicators of river quality, and also of some fish populations, as their parasitic larvae are dependent on fish hosts. Hydrobiid snails may indicate spring quality, and terrestrial species may also indicate changes in habitat quality; for example general declines in abundance of quite common species in Portugal (Helix aspersa amd Cepaea nemoralis) are thought to indicate environmental change (Albuquerque et al., 1990).

Molluscan shells make good fossils, and subfossil land and freshwater molluscs from Pleistocene and Holocene deposits can be used to interpret ancient local environments, including type of vegetation and degree of disturbance by man. In Great Britain for example there it appears that the activities of man since the Neolithic period has had an increasingly important influence on land snails. Although the effects are sometimes difficult to separate from those caused by climate change, agriculture, resulting in the drying out of soil, continuous habitat disturbance and the creation of grassland and dry habitats has led to a dominance of species adapted to this type of environment (Evans, 1972). At the same time, a certain level of diversity has been maintained through the creation by man of microhabitats such as ditches and hedgerows (Kerney, 1965).

Molluscs are of economic importance mainly as pests and parasites, but this concerns relatively few species. Two species in Europe have long been of positive economic importance: the freshwater pearl mussel and the Roman snail. In both cases, collecting over the centuries has had impacts on populations to a greater or lesser extent, and these problems are discussed later on. Molluscs have been used widely in science and education for many decades. Snails provide good laboratory material and are regularly used in genetic research on account of their comparatively short life cycles.

European Invertebrate Survey and Biological Recording Schemes

Biological recording and mapping schemes are playing a key role in the identification and conservation of threatened molluscs. Where there has been a long history of professional or amateur interest in a group, these schemes allow the examination and comparison of recent with historical records. For example, the mapping of terrestrial mollusc records in Belgium has shown a decline in the distributions of about 50 species (van Goethem, 1989). Kerney (1975 and 1982) illustrated how such schemes could be used on a regional as well as a national level.

The European Invertebrate Survey (EIS) was set up in 1969 to promote the collection and analysis of distribution data for European invertebrates. The UTM grid and the 50 x 50 km square were adopted as the most practical system for mapping. The E.I.S mapping scheme for molluscs was initiated in 1971 (Heath, 1973). Progress within each country has varied according to the number of malacologists available for such work and the interest of amateurs in undertaking field work. Information on national schemes is usually presented every three years at the International Malacological Congresses.

Austria No official scheme but maps can be found in Klemm (1974) and Reischtuz (1986).

Belgium Preliminary atlas produced in 1986 using UTM 10 km squares (De Wilde et al., 1986). The project is described in van Goethem et al. (1987).

Czechoslovakia No official scheme, but the non-marine molluscs of Slovakia have been mapped in Lisicky (1991).

Finland A land mollusc inventory and habitat register have been underway since 1970 at the Finnish Museum of Natural History;, using a 10 km square uniform Finnish grid system which could be correlated with the 50 km square UTM system (Valovirta, 1977). By 1991, the database held about 30,000 records (Valovirta in litt., 31.5.91), with more detailed information for the freshwater pearl mussel.

France: A mapping scheme and inventory were initiated in 1984, supported by the Secretariat Faune et Flore of the Ministry of Environment, which is aiming to update the work of Germain (1930/31) and produce maps of species in relation to their ecological parameters as well as their distributions (Andre, 1986 and 1989). An earlier mapping project by the Societe Francaise de Malacologie used the UTM 50 km square system, following the E.I.S. guidelines (Chevalier et al., 1972); a number of maps were produced and published in Haliotis but this project has not yet been completed. The Sphaeriidae have been inventoried, although not yet mapped (Mouthon & Kuiper, 1987)

Germany: Information has been gathered by each of the federal states in the west and most of this has been collated by the mapping group Projektgruppe Molluskenkartierung, established in 1972. A computerised database for the grid mapping was developed. Mapping is complete or relatively far advanced for most of the states (Jungbluth et al., 1986; Jungbluth and Burk, 1986) (Bavaria 1986, Baden-Wurttemberg 1980, Bremen 1989, Nordrhein-Westfalen 1989, Schleswig-Holstein 1989 (Wiese, 1989), Lower Saxony 1990, Berlin 1990 and Hesse 1976). Rhine-Palatine and Saarland are still to be completed. Numerous publications are available, but it has not been possible to list all this in this report. Additional material is still to be published. Separate mapping projects are underway for unionids. A mapping project was started recently for the east (Von Knorre, 1989).

Great Britain: A grid mapping scheme, based on 10 km square units, was initiated in 1961 by the Conchological Society of Great Britain, under the guidance of the Biological Records Centre. An atlas was produced in 1976 (Kerney, 1976) and there are plans for a revised edition. Data collection is an ongoing activity.

Hungary Atlas published in 1979 (Pinter et al., 1979) using E.I.S. system (10 sq km units) and data collected over a seven year period by collectors and from museum collections.

Ireland Maps for Ireland are included in Kerney (1976) and maps for 10 sq km records are also given in Ross (1984).

Netherlands Information not received, but mapping project underway.

Norway The sphaeriids were mapped and inventoried on a 50 km square UTM system by Okland and Kuiper (1980, 1982) and a detailed list of localities has been published (Okland and Kuiper, 1990). Freshwater gastropods have been mapped using 50 km square maps, as well as traditional dot maps in Okland (1990); locality lists are also given. Large freshwater mussels are mapped using the 50 km square UTM system by Okland (1983) and Okland and

Andersen (1985). With the exception of Margaritifera margaritifera, the distribution and regional ecology of freshwater molluscs are probably better known in Norway than in any other country. Terrestrial gastropods are currently being mapped by Dr H. Walden of Goteborg, Sweden.

Poland No official mapping scheme, but the sphaeriids have been mapped by Piechocki (1989) and the vertiginids by Pokrysko (1990) using the UTM grid.

Portugal No official scheme but work is moving towards cataloguing and mapping species (Albuquerque de Matos et al., 1990; Albuquerque de Matos in litt., 30.3.91)

Romania No official scheme; the four volume monograph (Grossu 1981, 1983, 1986, 1987) on gastropods gives distribution data and some maps.

Spain No official mapping scheme, but Ibanez et al. (1976) discuss the problems involved and preliminary ideas. The current Project Fauna Iberica involves the preparation of a catalogue with distribution data (Aparicio in litt., 14.2.91).

Sweden Data has been collected in the course of extensive field work by Dr H. Walden but there is no official mapping scheme and funding is still being sought for production of an atlas.

Switzerland A mollusc inventory and geographical habitat register is being developed under a project initiated in 1982/83 by the Swiss Federal Institute for Forest, Snow and Landscape Research. The habitat register takes into account all the main national collections, and the information will be mapped (Turner and Ruetschi, 1989). The work is being carried out in collaboration with the Societe Internationale de Conchyliologie.

Regional mapping efforts

Progress on regional mapping of mollusc distributions has been slow although Kerney (1975) provided examples of this over a decade ago. However, projects are underway for particular taxonomic groups. The Sphaeriidae (23 species) of northern Europe (Denmark, Faroes, Finland, Iceland, Norway and Sweden) were mapped by Kuiper et al. (1989) and mapping of this group throughout Europe is now underway by Dr J.G.J. Kuiper in Paris (Okland and Okland in litt., 1991). A project has recently been initiated to map the large freshwater mussels of northern Europe (eight species in the families Margaritiferidae, Unionidae, Dreissenidae) and provisional maps are to be available by 1993 (Okland in litt., 1990; von Proschwitz, 1990).

PRINCIPAL THREATS TO MOLLUSCS

Table 1 shows the number of threatened species in each country where figures are available. In many cases these may be underestimates. Whereas the first edition of the Finnish Red Data Book (Rassi and Vaisanen, 1987) contained 15 mollusc species, the second edition now in preparation will include 23 (Valovirta, 1991). Whether this is due to better information, or to increasing threats to molluscs is not known, but in either case, it reveals an increasingly serious situation. We do not have sufficient data for molluscs to produce statistics on a regional basis but figures for individual countries give some indication. Even where information for whole countries is not available, there are now signs of the scale of the problem. For example, in Modena Province in northern Italy, 47 of the terrestrial species and 14 of the known freshwater species have not been recorded since 1970 (Palazzi, 1983). Other European invertebrate groups show a similar picture: of the 380 butterfly species, about 25% are threatened or in decline; of the 164 dragonflies, about 38% are at risk (Collins, 1989).

Ecological requirements of non-marine molluscs

Although some molluscs seem to thrive on human disturbance, many non-marine species have exacting habitat requirements which contribute to their localized distributions and vulnerability. Optimal sites may include a combination of the following factors: a long stable history of land use (e.g. primary woodland, old grassland); calcareous soil or alkaline waters (although some species tolerate acidic conditions well); moisture (although many snails can survive dry periods by aestivating); shelter to limit dessication (such as dead wood, stone walls etc); mild temperature; a mosaic of vegetation types rather than uniform habitat; well oxygenated water and a stable water level for freshwater species.

The importance of avoiding dessication might suggest that slugs would be more at risk than snails with their protective shells. However, slugs tend to be less habitat specific, few are calciphile and most have wide ranges (although information on endemic species is still at an early stage). They are also adapted to a history of repeated local extinctions during dry years and rapid colonisation in wet years or seasons. As a result, few slugs feature in this report, although it should be remembered that further data could alter this: monitoring slug populations is very difficult because of their annual and seasonal fluctuations and the fact that finding them is very weather dependent. In contrast, snails tend to be comparativeluy sedentary and are much easier to find on account of their shells.

Habitat loss and disturbance

Almost all the species in this report are included because they occur in shrinking or increasingly degraded habitats and, in many cases, need traditional and now uneconomic, habitat management. Much degradation is caused by current European agricultural policy which is having a major impact on natural habitats (Baldock, 1990), but similar changes are taking place in countries unaffected by the EC's Common Agricultural Policy. The switch from traditional farming to intensive, large-scale agribusiness, with a focus on extensive monocultures has removed the mosaic of varied habitats in which many molluscs thrive.

The mollusc faunas of the Mediterranean and north-east Atlantic islands show high levels of endemism (see later for discussion of this), and many species are potentially threatened by their restricted ranges. This is of

particular concern given that one of the consequences of closer European integration is likely to be increased threats to fragile environments in Southern Europe through regional development grants for new roads, airports, tourist complexes, intensified agricultural and forestry production, dams and river canalisation.

Loss of woodland and forest: Many terrestrial molluscs require humid or wet conditions, living under dead logs or in leaf litter on the forest floor. Native woodlands, especially those that are long established and have a wide age profile tend to be very important for invertebrates, such as Geomalacus maculosus and Elona quimperiana (see data sheets). The loss of woodlands is a primary threat, combined with the widespread change from deciduous or mixed forest to conifer plantations that acidify the soil and do not provide suitable litter to give shelter. Other changes in forestry practise such as much greater forest 'hygiene' also reduce the variety of habitat available for invertebrates (Collins, 1989).

In Finland the replacement of copses of deciduous trees by spruce plantations has contributed to the decline of several species (Rassi and Vaisanen, 1987). In Sweden, Walden (1981) found richest molluscan diversity in broadleaf forest on calcareous moraine, and lowest diversity in pure stands of pine or spruce. Baba (1986) describes the impact of forestry planting on snail faunas in Hungary, and Cameron and Greenwood (1989) show that planted forests have significantly lower molluscan diversity in Scotland than do ancient woodlands. Strictly woodland species are at risk in Poland (Pokryszko in litt., 20.10.90). Many of the endemic species in the Madeiran islands such as those in the genus Leiostyla rely on native laurel forest, much of which has already been destroyed (see data sheet for Madeiran species).

Loss of hedgerows and grasslands: Hedgerows and calcareous grassland are important habitats for many species and are being rapidly lost. Mechanised farming has resulted in the loss of hedges that provide shelter. Calcareous grassland habitat has been lost through the use of fertilisers and has affected molluscs as well as other invertebrates such as butterflies (Collins, 1989). Trampling on grassland in recreational areas can lead to a reduction in the total number of snails, although the proportion of xerophile snails increases (Chappell et al., 1971), and may be a particular threat to species living in dunes.

Loss of wetlands: Fifteen of the widely distributed but declining species, described later in this report, are marsh or fen gastropods, or occur in slow moving or still water bodies. Their increasing rarity is clearly related to the disappearance of large areas of wetland over the last century, which has also affected other invertebrates (half of the threatened butterflies in Europe are wetland species (Collins, 1989)). Many are now restricted to remnant habitat although this may be scattered through several countries. Four species of the genus Vertigo are particularly at risk. Other species are also affected, although at a more local level. Several wetland species are at risk in Finland (Valovirta, 1991) and in Poland, where many vertiginids are threatened (Prokryszko, 1990; and in litt., 20.10.90). Several succineids are vulnerable to wetland loss. Many of the freshwater molluscs in Greece are threatened by the lowering of the water table for human consumption (Mylonas, in litt, 1990). The Melanopsidae, a little known group of freshwater prosobranchs may be threatened by habitat loss in the western Mediterranean (Altaba, 1989). River and spring species are threatened by hydrological engineering and drainage (see discussions on hydrobiids and unionids).

Pollution

This is probably the most serious threat to many freshwater molluscs. Many species are very sensitive to changes in water quality, partly because of their permeable 'skins' and also because of their need for a good oxygen supply.

Freshwater snails are sensitive to acid water (Okland and Okland, 1986) and there are documented cases of species having disappeared in parallel with acidification (see Okland, 1990). In Sweden Valvata macrostoma disappeared in one lake when pH dropped from 6.3 (in 1943) to 4.5-4.6 (in 1967) and 5.2-5.5 (in 1973). In some Swedish rivers it was not possible to confirm the presence of Ancylus fluviatilis in 1980, and 'empty' rivers had a significantly lower pH compared with localities where the species still occurred. In Norway, Lymnaea peregra, Gyraulus albus and Acroloxus lacustris were found at pH 5.2 (their extreme lower tolerance limit) in one lake in 1954. When this lake was revisited in 1987, the pH had dropped to 4.2 and no snails were found (Okland, 1990).

Considerable work has been carried out in northern Italy on the impact of heavy metals (e.g. Ravera, 1977), radioactivity (e.g. Ravera, 1966; Riccardi and Ravera, 1989) and other pollution (e.g. Mariani and Ravera, 1977) on freshwater molluscs. The distribution of molluscs in lakes and ponds has also been found to be influenced by eutrophication (Annoni et al., 1978).

Freshwater molluscs most at risk from pollution include the unionids or freshwater mussels, for which there is currently perhaps of greatest concern (this report includes data sheets for six species), the relict lake faunas of Baikal and Ohrid, the endemic molluscs of the Danube, and the endemic spring-dwelling and ground water hydrobiids.

Terrestrial molluscs may also be vulnerable to pollution, particularly in the form of acid rain. Atmospheric pollution with sulphur dioxide is known to have an adverse effect on Balea perversa (see data sheet) and Clausilia bidentata (Holyoak, 1978). In Sweden, a number of areas surveyed between 1941 and 1966 have recently been resurveyed, revealing declines of 25-77% in the molluscan faunas which have been attributed to acid rain.

Walden (1989) reports a study of the impact of heavy metal pollution on molluscs at a copper mill in northern Norway. The gradient of metal pollution stretching down the valley away from the mill was inversely correlated with diversity and abundance of molluscs. Other studies on the effect of pollutants on molluscs include Beeby (1985), Beeby and Eaves (1983) and Williamson (1980). Overall, the literature is patchy and it is difficult to pinpoint particular pollutants as threatening particular species, but pollution clearly has an impact on many freshwater species and may also affect some terrestrial species.

Exploitation

Collecting threatens very few European species. The exceptions are the larger species of commercial value, most notably Margaritifera margaritifera and the edible Helicidae. The former has been seriously affected by collecting for pearls (see data sheet). Several helicids are collected for food throughout Europe (Helix pomatia, H. aspersa, Theba pisana, Cepea nemoralis, Iberus spp., Iberellus spp.) but show considerable resistance to exploitation. They are still tend to be abundant in much of their ranges, although there are certainly areas where collecting has caused declines (e.g. Portugal (Albuquerque de Matos et al., 1990; Albuquerque de Matos in litt., 4.10.90), Spain, Italy, Greece and see data sheet for Helix pomatia), and in this cases, populations should be monitored.

Introduced species

This is potentially a threat to freshwater species, but there are few documented cases of problems at the moment. The Zebra mussel Dreissena polymorpha has been introduced in many lakes and rivers in Europe but its impact on native species is not clear. Corbicula, the Asiatic clam, was introduced to France, Spain and Portugal in about 1975. Although not yet a problem in Europe, the fact that it rapidly assumed pest population sizes in the USA following its introduction there early this century (McMahon, 1982) means that it poses a potential threat here (Mouthon, 1981; Britton, 1973). At present, there are no known threats to European molluscs from introduced predators, as is the case in many tropical countries where biological control programmes for pests such as the Giant African Snail Achatina fulica, have led to the introduction of carnivorous snails such as Euglandina rosea with dire consequences for native species (e.g. Murray et al., 1988).

Climate change

The present European mollusc fauna became established in the post-glacial, as molluscs were severely influenced by the Ice Ages of the Pleistocene. Climate changes since then have also had a considerable impact, and may be continuing to do so today. This makes it difficult to determine exactly which changes are due to humans (compounded by the fact that humans are themselves now altering the climate). However, there is general agreement that in the last two centuries the growth in human populations and the subsequent impact on the environment has had a greater influence on molluscs that climate.

THREATENED SPECIES

The threatened molluscs that have been identified can be divided into three categories:

a. Single country endemics
b. 'Near' endemics and geographically restricted species
c. Widespread species that are declining throughout Europe

These groups are discussed separately in the following sections. Where sufficient data are available, data sheets, using a standardised format, have been compiled. The format is based on that devised for the EIS/Bern Convention project (Speight, 1990) with a few minor alterations: common names have been given where these are known; the 'bibliography' heading has been omitted; and the references are cited at the end of this report, rather than in the data sheet itself (this is for reasons of space). For some of the narrow endemics, data sheets have been compiled for groups of species, principally if similar threats and conservation requirements apply to all members of the group. Some of the statements in the data sheets are not referenced; in most cases this is because they concern information taken from the relevant country table (see Annex). In some cases there are two IUCN categories for a species in a country. This is usually because there is some doubt or disagreement, but in the case of Germany it reflects the fact that information has been collected separately for west and east; the first category is for the west, the second for the east.

Other species are listed with the suggested IUCN category and brief information on distribution and status as this is available. Further information is available in the country tables (which will be available as a separate Annex on request). The section on single country endemics lists non-threatened as well as threatened endemic species, since in many cases the former could quickly become of conservation concern.

Threat categories

The IUCN categories have been used in this report, with the addition of a category for species 'Of Special Concern' (see below). This is equivalent to the numerical category 4 used in the national Red Data Books and threatened species lists of several European countries (although the UK Red Data Book uses '4' for species threatened but for which conservation efforts have already been successful).

The definitions of the categories used are as follows:

EXTINCT (Ex)
Species not definitely located in the wild during the past 50 years

ENDANGERED (E) Taxa in danger of extinction and whose survival is unlikely if the causal factors continue operating.

> Included are taxa whose numbers have been reduced to a critical level or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction. Also included are taxa that are possibly already extinct but have definitely been seen in the wild in the past 50 years.

VULNERABLE (V)
Taxa believed to move into the 'Endangered' category in the near future if the causal factors continue operating.

Included are taxa of which most or all the populations are decreasing because of over-exploitation, extensive destruction of habitat or other environmental disturbance; taxa with populations that have been seriously depleted and whose ultimate security has not yet been assured; and taxa with populations which are still abundant but are under threat from severe adverse factors throughout their range.

RARE (R)
Taxa with small world populations that are not at present 'Endangered' or 'Vulnerable', but are at risk.

These taxa are usually localised within restricted geographical areas or habitats, or are thinly scattered over a more extensive range.

INDETERMINATE (I)
Taxa known to be 'Endangered', 'Vulnerable', or 'Rare' but where there is not enough information to say which of the three categories is appropriate.

INSUFFICIENTLY KNOWN (K)
Taxa that are suspected but not definitely known to belong to any of the above categories, because of lack of information.

OF SPECIAL CONCERN (S)
Taxa that are still widespread or relatively abundant but that have undergone an observable decline and are potentially threatened.

This category is based on category 4 used in the Red Data Lists for Sweden, Germany, Austria and Switzerland, and the category Md used in the Red Data Book for Finland.

NOT THREATENED (nt)

SINGLE COUNTRY OR TERRITORY ENDEMICS

Endemic species with their small ranges are potentially most at risk, but in many cases they are least well known because of their inaccessible habitats and remoteness. In some cases this may work in their favour, for example if they are in remote mountain ranges far from human impact, but it is important that their populations are monitored as they are potentially vulnerable to even a single major impact. Over 200 endemics are known to be at risk in Europe (see below), based on information gathered for this report. Given the paucity of information about most endemics, this is likely to represent a small proportion of actual threatened species.

Island species

The propensity for molluscs to speciate on islands is well documented (e.g. Solem, 1984), as is the vulnerability of island invertebrate faunas to human activities (e.g. Wells et al., 1983). Molluscs have low vagility and tend to speciate within confined areas, which makes them vulnerable to single disruptive events. The endemic molluscan faunas of the islands of the north-east Atlantic and of the Mediterranean are potentially at risk for this reason.

The terrestrial molluscs of the Azores, Madeira, the Canary Islands (Macaronesia) and the Cape Verdes are essentially a relict assemblage and are of great conservation concern. These faunas have a common background but very few taxa are shared by the archipelagos due to differences in geological history, climate and geographical location in relation to the continental mainland. Very few species are common to all archipelagos, and only about 4 out of nearly 400 taxa are common to more than one (Walden 1984 a and b). Genera endemic to the Atlantic islands as a group are Craspedopoma, Napaeus, Janulus, Heterostoma, Spirorbula, Actinella, and Leptaxis. This situation is similar to that for other flightless invertebrates such as isopods and millipedes on the islands, which also have high endemism at the genus and species level but not at higher taxonomic levels. On Madeira for example, about 90% of the molluscan endemics belong to only four families (Cameron and Cook, 1989). This pattern is also seen in mollusc radiation on other islands around the world. Approximate numbers of endemics in each archipelago are given in table 1.

Madeira, with its markedly high diversity and endemism, has a key position as a centre of evolution and for dispersal to other archipelagos. It has nothing in common with the fauna of the adjacent north-west African mainland, its affinities being strictly European (Walden, 1984 a and b). Levels of endemism are probably rivalled only by Hawaii, Rapa and some of the other tropical islands in the Pacific (Solem, 1984), with fourteen endemic genera (Staurodon, Boettgeria, Hemilauria, Amphorella, Pyrgella, Cyclichnidia, Steenbergia, Geomitra, Caseolus, Disculella, Lemniscia, Discula, Pseudocampylaea, Lampadia). The Canaries have much stronger African affinities, and have several endemic genera (e.g.Gibbulinella, Vermetum, Monilearia, Canariella, Hemicycla). The Cape Verde islands have a substantial African element in their fauna and are not considered further in this report.

Data sheets have been compiled for the threatened endemics of Madeira and of Tenerife, the island best documented in the Canaries. Both illustrate the importance of the remaining stands of natural vegetation in these islands to the endemic species, and the severe pressure that this is under from development and other human activities.

The molluscan faunas of the Mediterranean islands are less well documented and major taxonomic revisions are underway for many of the

important groups. Levels of endemism are lower than on the Atlantic islands. Several genera appear to be endemic, such as Tacheocampylaea (Corsica and Sardinia) and Lampedusa (Malta, Lampedusa). Several species are endemic to the Tuscan and Eolian archipelagos.

Information for the Balearics, Sardinia, Sicily, Lampedusa and some of the other small islands is particularly poor. The endemic faunas of Majorca and Minorca have been documented but it was not possible to obtain the information for this report; the Pitusas (Ibiza and Formentera) have rather fewer endemics (Sacchi, 19xx). Sufficient information was obtained for Corsica, Malta and Gibraltar to provide some idea of status and data sheets have been compiled for these islands. As with the Atlantic islands, many of the endemic species are now threatened on account of their small ranges and the potential loss of habitat from a variety of human activities.

In Greece, 40-50% of the mollusc fauna of the Aegean Islands is probably endemic (Mylonas, 1984) and endemism throughout the Greek islands is markedly high (Kemperman and Gittenberger, 1990; Bar and Butot, 1986). This is largely due to the presence in this region of numerous islands, caves and karst habitats, all of which encourage speciation, as well as the central position of Greece between the zoogeographic regions of Europe, Africa and Asia (Legakis, 1990). Endemism is particularly high in the families Clausiliidae and Enidae and in the genera Vitrea, Zonites and Deroceras. All these are rocky ground or subterranean dwellers with restricted mobility (Bar and Butot, 1986). The genus Albinaria (Clausiliidae) restricted to Greece and adjacent countries has recently speciated into a bewildering variety of species, subspecies and local forms. Work is currently underway in Crete, the eastern Peloponnese and Kephallina by Gittenberger and his co-workers to unravel this. Albinaria endemics on Cyprus have scattered localised distributions (Gittenberger and Neuteboom, 1989) and therefore could be at risk, but more detailed data are lacking. Of the eight species of Mastus (Enidae) in the Aegean, five are endemic to the Greek islands (Vardinoyannis-Pavlakis et al., 1989).

Other terrestrial species

Large numbers of endemic species are found on the mainland of Southern Europe, particularly in mountainous regions such as the Pyrenees, Carpathians, Caucasus, Balkans and peninsular Italy. Data sheets in the next section illustrate some of these, but in general there is very little information to indicate levels of threat for these species. Many relict species with small ranges may be vulnerable.

Extensive taxonomic work is underway in Italy and Spain and knowledge of the fauna is increasing rapidly. This means that it is impossible to compile a list of endemic species that is anywhere near complete, but the information gathered for this report gives some indications of the faunal richness of these countries; as will be seen from the lists, many species have been described in the last decade.

Liguria (Italy) in the Alpes-Maritimes is one area of particular concern; a glacial refuge which has escaped extreme climatic conditions, it has 144 terrestrial molluscs and 25 freshwater species of which many are endemic. High diversities and endemism are also found in the adjacent areas of the Alpes-Maritimes, partly due to the varied faunal components (alpine, mediterranean and endemic) of this region (Boato et al., 1982; Bodon and Boato, 1987; Boato, 1988). Numerous species are endemic to the Iberian peninsula, with many endemic genera such as Iberus (which exhibits rich polymorphism in eatern Andalusia), Oestophora, Xeroplexa (= Trochoidea) (Sacchii, Gasull etc.), and Pyrenaeria (which is endemic to the Spanish Pyrennees apart from one species on the French side (Bouchet, 1990)). It has not been possible to sort out the species that are specifically endemic to Portugal, Spain or the offshore islands, and there is little information on threats, despite considerable concern.

Very preliminary information was obtained for Yugloslavia, which almost certainly has one of the highest levels of endemism, but a major task lies ahead in listing these species and their status.

Groundwater and spring species

Numerous hydrobiid species, found mainly in springs and subterranean waters, were described in Europe in the last century but are of questionable taxonomic status. These faunas are being studied in several countries and it is becoming clear that although there may be fewer species than originally thought, many are indeed endemic to small areas and are under threat. General information on species found primarily in subterranean waters can be found in Bole and Velkovrh (1986), a reference that was not consulted for this report.

About 200 hydrobiids were described from France; Germain (1931) recognised only 60 as valid species and recent work has shown that many of these descriptions, often based on shell characters alone, are not valid. Their taxonomy is currently being reworked for France and Switzerland Jura by Boeters and Bernasconi. This makes the identification of threatened species difficult, but the vast majority of them are known only from very restricted ranges and from the literature often appear to be endemic to single springs or wells. In some cases, known ranges may reflect localities in which they can be easily collected, rather than their true habitat. Several genera, in particular Bythiospeum, Moitessieria, Paladilhia and Horatia, live in subterranean waters or in the underground parts of rivers. However, others appear to be genuinely restricted to small localities. For example, Bythinella appears to be a true inhabitant of springs and is not known from underground waters. Some hydrobiids are therefore very vulnerable to capping or diversion of springs and to pollution of the groundwater, for example in Poland (Falniowskii in litt., 2.11.90). In France, three rocky calcareous regions are notable for the diversity of their endemic hydrobiids: the Pyrenees, at lower and middle altitudes; the upper valleys of the small coastal rivers that drain the hills bordering the Mediterranean and the Jura (Bouchet, 1990); thirteen hydrobiids are endemic to the Rhone basin. Some of these species are described in the following data sheets.

Numerous subterranean species have been decribed from Italy. Pezzolli (1988a) gives a region by region overview of species from springs and truly subterranean species for northern Italy: Piemonte has one endemic, Liguria has four, Lombardy has two, east and west Veneto has five. The south has been less well studied but three endemics are known from Tuscany, two from Umbria, one from Lazio and one from Sardinia. Many of these species are considered to be at severe risk (Pezzoli 1988 b and c). For example, the Valle Imagua in Bergamo and the Brescia area (both in Lombardy) are particularly important sites for endemic species but many of the caves and springs are now damaged, with many springs capped with concrete. No efforts have yet been made to safeguard them (Pezzoli, 1990).

Austria, Yugoslavia and Greece also have major hydrobiid faunas, and many cave species, such as those in the genus Bythiospeum have probably never been described. The Yugoslavian fauna has been well documented by Botoseanu, but this information was not obtained in time for inclusion.

Lake species

The most striking endemic lake faunas are those of Lake Baikal and Lake Ohrid, both of which are treated in separate data sheets. Boss (1978) considered these radiations comparable to those of Darwin's finches in the Galapagos and the drosophilid flies in Hawaii. The faunas of both lakes can be divided into two groups: a) pulmonates which live in the shallow waters around the periphery, with few endemics and b) prosobranchs and

endemic pulmonates living in the main body of the lake. In both lakes there are many more endemic prosobranchs than pulmonates, and the hydrobiids show the greatest radiations; in Lake Baikal there is an endemic hydrobiid subfamily or family (Baikaliinae/ Baikaliidae). The comparative lack of speciation within the pulmonates can best be explained by there shallow habitat which permits passive dispersal by birds and other means. The prosobranchs are also livebearers which may contribute to their ability to speciate (Boss, 1978).

In both cases, rather little is known of the status of the endemics, although it is thought that shore development and pollution are potential threats. None of the Baikal species are listed in the current Red Data Book for the USSR, but they are being considered for the next edition (Kotchetova pers. comm.). Such is the significance of both areas for their unique wildlife, that major conservation efforts are underway, but information is not available to indicate the extent to which these are taking mollusc faunas into account.

Other lakes with notable endemic species include Lake Trichonis in Greece and the Caspian Sea. Neither has been treated in detail in this report, but further information should be gathered. Neither the Caspian nor Aral Sea have European faunas, but the Caspian Sea fauna includes many brackishwater species and so is not strictly within the remit of this report. The molluscs of the Aral Sea are potentially at greatest risk, on account of its rapid evaporation and loss of water, but the fauna is comparatively poor with few endemics (Zhadin, 1965).

ENDEMICS BY COUNTRY OR TERRITORY

Endemic subspecies have generally not been listed. Some of the hydrobiids listed are of dubious taxonomic status, but have been included to illustrate that this is an important taxonomic group to be considered in terms of endemism. The list is incomplete for several countries, and in some cases only the species considered threatened have been listed. For some countries, the latter are also described in data sheets which can be found at the end of this section; these species are marked in the list with a *.

? = IUCN category not known or doubtful taxonomy

AUSTRIA (threatened species only)

Family Hydrobiidae	
Alzoniella hartwigschuetti (Reischutz, 1983)	V
Belgrandiella austriana (Radoman, 1975)	E
Belgrandiella fuchsi (Boeters, 1970)	E
Belgrandiella lacheineri (Kuster, 1852)	V
Belgrandiella parreyssi (L. Pfeiffer, 1841)	E
Belgrandiella pupula	V
Belgrandiella styriaca Stojaspal, 1978	E
Bythinella cylindrica	R
Bythinella intermedia (Mahler, in Boeters, 1970)	Ex
Bythiospeum cisterciensorum (Resichutz, 1983)	E
Bythiospeum elseri (Fuchs, 1929)	E
Bythiospeum geyeri (Fuchs, 1925)	E
Bythiospeum noricum (Fuchs, 1929)	E
Bythiospeum pfeifferi (Clessin, 1887)	Ex
Bythiospeum reisalpense (Reischutz, 1983)	E
Bythiospeum tschapecki (Clessin 1878)	Ex?
Hauffenia kerschneri (Zimmermann, 1930)	E
Iglica gratulabunda (A.J. Wagner, 1927)	Ex?
Lobaunia danubialis Haase in press	E
Family Orculidae	
Orcula austriaca (St. Zimmerman, 1932)	V
Orcula fuchsi Zimmerman, 1831	R
Orcula pseudodolium (A.J. Wagneri, 1912)	V/R
Family Arionidae	
Arion obesoductus Reischutz, 1973	R
Family Limacidae	
Deroceras sp.	V?
Family Helicidae	
Chilostoma ziegleri (Rossmassler, 1836)	Ex
Cylindrus obtusus (draparnaud, 1805)	V/nt
Petasina subtecta (Polinski, 1929)	V
Trichia oreinos (A.J. Wagner, 1915)	E/V

AZORES (PORTUGAL) (incomplete list)

Family Cyclophoridae	
Craspedoma hespericum (Morelet & Brouet, 1857)	V
Family Pupillidae	
Lauria fasciolata (Morelet, 1860)	?
Leiostyla fuscidula (Morelet, 1860)	?
Leiostyla rugulosa (Morelet, 1860)	?
Leiostyla tesselata (Morelet, 1860)	?
Leiostyla vermiculosa (Morelet, 1860)	?
Family Vallonidae	
Spermodea monas (Morelet, 1860)	?

Family Enidae	
'Napaeus' alabastrinus Martins, 1989	R
'Napaeus' delibutus (Morelet & Drouet, 1857)	?
'Napaeus' forbesianus (Morelet & Drouet, 1857)	?
'Napaeus' hartungi (Morelet & Drouet, 1857)	?
'Napaeus' pruninus (Gould, 1848)	?
'Napaeus' tremulans (Mousson, 1858)	?
'Napaeus' vulgaris (Morelet & Drouet, 1857)	?
Family Endondontidae	
Punctum azoricum De Winter, 1988	?
Family Vitrinidae	
Phenacolimax atlantica (Morelet, 1860)	R
Phenacolimax brumalis (Morelet, 1860)	?
Phenacolimax pelagica (Morelet, 1860)	?
Family Zonitidae	
Oxychilus agostinhoi Martins, 1981	E
Oxychilus atlanticus (Morelet & Drouet, 1857)	?
Oxychilus brincki Riedel, 1964	?
Oxychilus furtadoi Martins, 1989	?
Oxychilus juvenostriatus Riedel, 1964	?
Oxychilus miceui Martins, 1989	?
Oxychilus miguelinus (Pfeiffer, 1856)	?
Oxychilus minor (Morelet, 1860)	?
Oxychilus ornatus Riedel, 1964	?
Oxychilus spectabilis (Milne-Edwards, 1885)	?
Oxychilus volutella (Pfeiffer, 1856)	?
Zonitoides azoricus Riedel, 1964	?
Family Clausiliidae	
Balea nitida Mousson, 1858	?
Family Helicidae	
Actinella horripila (Morelet & Drouet, 1857)	?
Actinella vespertina (Morelet, 1860)	?
Actinella sp. 1	?
Actinella sp. 2	?
Cernuella ?obruta (Morelt, 1860)	?
Helixena sanctaemariae (Morelet & Drouet, 1857)	?
Leptaxis azorica (Albers, 1852)	?
Leptaxis caldeirarum (Morelet & Drouet, 1857)	?
Leptaxis drouetiana (Morelet, 1860)	?
Leptaxis terceirana (Morelet, 1860)	?
Leptaxis sp.	?

BALEARIC ISLANDS (SPAIN) (incomplete list)

Family Hydrobiidae	
Amnicola balearicus Pal.	?
Family Clausiliidae	
Iberellus balearicus Pfeiffer	?
Iberellus graellsianus Pfeiffer	?
Iberellus minoricensis Mittre	?
Family Zonitidae	
Oxychilus pityusanus Riedel, 1969	?
Vitrea gasulli Riedel & Paul, 1978	nt
Family Helicidae	
Helicella cardonae Hid.	?
Helicella caroli Dohn & Heynemann	?
Helicella cisternasi Hid.	?
Helicella ebusitana Hid.	?
Helicella frater Dohn & Heynemann	?
Helicella majoricensis Dorhn	?
Helicella molinae Hid.	?

Helicella moraguesi Hid.	?
Helicella nyeli Mittre	?
Helicella pollenzensis Hid.	?
Trochoidea ebusitana (Hidalgo, 1869)	nt
Trochoidea caroli (Dohrn & Heynemann, 1862)	nt
Tudorella ferruginea Lamarck	?

BULGARIA (incomplete list)

Family Hydrobiidae

Belgrandiella angelovi Rinter	?
Belgrandiella bureschi Angelov	?
Belgrandiella hessei Wagner	?
Belgrandiella zascheri Angelov	?
Hauffenia lucidulus Angelov	?
Iglica acicularis Angelov	?
Isignia macrostoma Angelov	?
Paladilhia bureschi Wagner	?

CANARY IS (SPAIN) (list complete for Tenerife only)
(see data sheet for 'Tenerife endemics')

Family Cyclophoridae	
Craspedoma costata (Shuttleworth, 1852)	R
Family Pomatiasidae	
Pomatias laevigatus (Webb & Berthelot, 1833)	nt
Pomatias raricosta (Wollaston, 1878)*	V
Family Planorbidae	
Nautilinus clymene (Shuttleworth, 1852)*	R
Family Vertiginidae	
Leiostyla castanea (Shuttleworth, 1852)	nt
Truncatellina atomus (Shuttleworth, 1852)*	K
Family Enidae	
Napaeus badiosus (Ferussac, 1821)*	V
Napaeus baeticatus (Webb & Berthelot, 1833)	nt
Napaeus helvolus (Webb & Berthelot, 1833)	nt
Napaeus nanodes (Shuttleworth, 1852)*	R
Napaeus propinquus (Shuttleworth, 1852)*	R
Napaeus roccellicola (Webb & Berthelot, 1833)*	V
Napaeus tabidus (Webb & Berthelot, 1833)	nt
Napaeus variatus (Webb & Berthelot, 1833)*	V
Family Vallonidae	
Acanthinula spinifera (Mousson, 1872)	R
Family Ferussaciidae	
Ferussacia reissi (Mousson, 1872)	nt
Family Zonitidae	
Retinella circumsessa (Shuttleworth, 1852)	nt
Family Endodontidae	
Discus engonata (Shuttleworth, 1852)*	R
Discus scutula (Shuttleworth, 1852)*	R
Family Vitrinidae	
Guerrina cuticula (Shuttleworth, 1852)	nt
Insulivitrina blauneri (Shuttleworth, 1852)	nt
Insulivitrina canariensis (Mousson, 1872)	nt
Insulivitrina eceroensis Alonso & Ibanez, 1987	nt
Insulivitrina emmersoni Morales, 1988	nt
Insulivitrina gomerensis Alonso & Ibanez, 1988	nt
Insulivitrina lamarcki (Ferussac, 1821)	nt
Insulivitrina latebasis (Mousson, 1872)	nt
Insulivitrina machadoi Ibanez & Alonso, 1990	R
Insulivitrina mascaensis Morales, 1987*	R

Insulivitrina nogalesi Alonso & Ibanez, 1990	nt
Insulivitrina oromii Ibanez & Alonso	nt
Insulivitrina parryi (Gude, 1896)	nt
Insulivitrina reticulata (Mousson, 1872)*	E
Insulivitrina tamaranensis Valido, 1990	nt
Insulivitrina tuberculata Ibanez & Alonso, 1987	nt
Family Parmacellidae	
Parmacella tenerifensis Alonso,Ibanez & Diaz,1985*	V
Family Limacidae	
Malacolimax wiktori Alonso & Ibanez, 1989*	V
Family Streptaxidae	
Gibbulinella dealbata (Webb & Berthelot, 1833)	nt
Family Hygromiidae	
Canariella fortunata (Shuttleworth, 1852)*	V
Canariella hispidula (Lamarck, 1822)	nt
Canariella leprosa (Shuttleworth, 1852)*	V
Canariella pthonera (Mabille, 1883)*	V
Canariella planaria (Lamarck, 1822)	nt
Canariella plutonia (Lowe, 1861)	nt
Family Helicidae	
Hemicycla adansoni (Webb & Berthelot, 1833)*	V
Hemicycla berkeleyi (Lowe, 1861)	R
Hemicycla bethencourtiana (Shuttleworth, 1852)	nt
Hemicycla bidentalis (Lamarck, 1821)	nt
Hemicycla consobrina (Ferussac, 1821)	nt
Hemicycla glyceia (Mabille, 1882)*	V
Hemicycla incisogranulata (Mousson, 1872)	nt
Hemicycla inutilis (Mousson, 1872)*	V
Hemicycla mascaensis Alonso & Ibanez, 1988*	V
Hemicycla modesta (Ferussac, 1821)*	E
Hemicycla plicaria (Lamarck, 1816)*	E
Hemicycla pouchet (Ferussac, 1821)*	V
Hemicycla saponacea (Lowe, 1861)	nt
Monilearia phalerata (Webb & Berthelot, 1833)	nt
Pleuropunctum? placidus (Shuttleworth, 1852)	K
Theba geminata (Mousson, 1857)	nt
Theba grasseti (Mousson, 1872)	?
Theba impugnata (Mousson, 1857)	?
Xerotricha nubivaga (Mabille, 1882)*	R
Xerotricha orbignyi (Orbigny, 1839)	nt
Xerotricha pavida Mousson, 1872	K
CORSICA (FRANCE)	
Family Cyclophoridae	
?Cochlostoma cyrniacum Mabille 1869	R?
Family Cochlicopidae	
Hypnophila remyi Boettger 1949*	I
Family Clausiliidae	
Cochlodina meisneriana Shuttleworth 1843	nt
Family Limacidae	
Deroceras cazioti (Pollonera, 1896)	nt
Family Zonitidae	
Oxychilus tropidophorus Mabille 1869	nt
Family Helicidae	
Cyrnotheba corsica (Shuttleworth 1843)*(=Monacha)	I
Helix ceratina Pfeiffer 1843* (= tristis)	I
?Monacha perlevis Shuttleworth 1852	?
Tacheocampylaea raspaili (Payraudeau 1826)*	I
Family Unionidae	
Unio turtoni Payraudeau 1826*	R

CYPRUS (list incomplete)

Family Clausiliidae	
Albinaria greeni Tomlin, 1935	?
Albinaria mavromoustakis Brandt, 1961	?
Albinaria rollei (Boettger, 1896)q	?
Albinaria saxatilis (Pfeiffer, 1846)	?
Albinaria virgo (Mousson, 1854)	?
Family Helicidae	
Trochoidea mavromoustakis (Hass, 1933)	?

CZECHOSLOVAKIA

Family Hydrobiidae	
Belgrandiella alticola Lozek & Brtek, 1964	S
Belgrandiella bojnicensis Lozek & Brtek, 1964	S
Belgrandiella kalasi Lozek & Brtek	Ex
Belgrandiella komenskyi Hudec, 1972	R/K
Belgrandiella slovenica Lozek & Brtek, 1964	S
Family Pupillidae	
Chondrina tatrica (Lozec, 1948)	S
Spelaeodiscus tatricus (Hazay, 1883)	E

endemic to Belanske Tatry mountains, in the area of the Sucha delina valley; most of its small range lies within the Tatra National Park and is well protected although tourism could pose a threat (Steffek, 1989); distribution mapped in Lisicky (1991).

Family Clausiliidae	
Bulgarica nitidosa Ulicny, 1893	?V
Family Arionidae	
Arion vejdorskyi Babor & Kostal, 1893	K
Family Limacidae	
Deroceras fatrense Macha, 1981	V
Family Helicidae	
Chilostoma rossmassleri Pfeiffer, 1842	S

FRANCE

(threatened endemics described in data sheets for Pyrenees-Occidentales, and Alpes-Maritimes)

Family Cyclophoridae	
Obscurella apricum (Mousson, 18470	nt
Obscurella nouleti (Dupuy, 1850)	nt
Family Hydrobiidae	
Arganiella exilis (Paladilhe, 1867) (=*Horatia*)	I
Belgrandiella pyrenaica Boeters, 1983*	I
Bythinella bicarinata (des Moulins, 1827)	I
Bythinella carinulata (Drouet, 1868)	I
Bythinella vesontiana (Bernasconi, 1989)	I
Bythinella viridis (Poiret, 1801)	I
Bythiospeum articense Bernasconi, 1985	I
Bythiospeum bressanum Bernasconi, 1985	I
Bythiospeum diaphanum (Michaud, 1831)	I
Bythiospeum garneri (Sayn, 1889)	I
Fissuria boui Boeters, 1981	I
Hydrobia scamandri Boeters, Monod & Vala, 1977	I
Litthabitella elliptica (Paladilhe, 1874)*	I
Moitessieria juvenisanguis Boeters & Gittenberger 1990	I
Moitessieria lineolata Coutagne, 1882	I
Moitessieria locardi (Coutagne 1883)	I
Moitessieria puteana (Coutagne 1883)	I
Moitessieria rayi (Locard, 1883) (= *Lartetia*)	I
Moitessieria rolandiana (Bourguignat, 1863)	I

Palacanthilhiopsis vervierii Bernasconi 1988	I
Paladilhia pleurotoma Bourguignat, 1865	I
Paladilhiopis bourguignati (Paladilhe 1866)	I
Plagigeyeria conilis Boeters 1974	I
Pseudamnicola anteisensis (Berenguier, 1882)	I
Pseudamnicola klemmi Boeters 1969	I
Family Aciculidae	
Platyla foliniana (Nevill, 1879)*	R
Renea gormonti Boeters,Gittenberger & Subai1989*	R
Renea moutonii (Dupuy, 1849)	nt
Renea paillona Boeters,Gittenberger & Subai1989*	R
Renea singularis (Pollonera, 1905)	nt
Family Pupillidae	
Solatopupa cianensis (Caziot, 1910)	nt
Family Vertiginidae	
Truncatellina arcyensis Klemm, 1943	nt
Family Limacidae	
Deroceras chevallieri Altena, 1973	R?
Family Helicidae	
Macularia saintyvesi (Kobelt, 1906)	nt
Monacha atacis Gittenberger & de Winter 1985	nt
Monachoides ventouxiana (Forcart, 1946)	nt

Parmacella gervaisi Moquin-Tandon, 1850 and Parmacella moquini Bourguignat, 1859 (Family Parmacellidae) have been considered as recently extinct endemics; known only from the Crau in southern France, they have not been seen since they were discovered; their disappearance is probably related to the widespread development in the Crau region (Bouchet, 1990). Kerney et al. (1983) considered them to belong to the Iberian species P. valenciennii, which is now thought incorrect, but it is possible that P. gervaisi is in fact P. deshayesi and that it is an introduction from Algeria (de Winter in litt., 11.3.91).

GERMANY (threatened species only)

Family Hydrobiidae	
Bythinella badensis Boeters, 1981	E
Bythinella bavarica Clessin, 1877	E
Bythinella compressa (v. Frauenfeld, 1856)	E
Bythinella dunkeri (v. Frauenfeld, 1856)	E
Bythiospeum acicula (Held, 1837)	E
Bythiospeum quenstedti (Wiedersheim, 1873)	E
Bythiospeum sandbergeri (Flach, 1886)	E
Family Vallonidae	
Vallonia allamanica Geyer, 1908	E
Vallonia suevica Geyer, 1908	E
Family Arionidae	
Arion simrothi Kunkel (in Geyer) 1909	Ex
Family Helicidae	
Trichia gramnicola Falkner, 1973	R

GIBRALTAR

Family Aciculidae	
Acicula norrisi Gittenberger & Boeters, 1977*	R
Family Ferussaciidae	
Cecilioides spp.*	I
Cecilioides connollyi Tomlin, 1943	I
Oestophora calpeana (Morelet, 1854)*	I

GREECE (list very incomplete)

Family Moitessieriidae	
Clameia brooki Boeters & Gittenberger, 1990	?
Family Hydrobiidae	
Dianella thiesseana (Kobelt, 1878)	?
Islamia trichoniana Radoman, 1978	?
Pseudoislamia balkanica Radoman, 1978	?
Trichonia kephalovrissonia Radoman, 1973	?
Trichonia trichonia Radoman, 1973	?
Family Moitessieriidae	
Clameia brooki Boeters & Gittenberger, 1990	?
Family Orculidae	
Pagodulina hauseri Gittenberger, 1978	?
Family Clausiliidae	
Albinaria brevicollis (Ferussac)	?
Albinaria coerulea (Ferussac)	?
Albinaria discolor (Pfeiffer)	?
Albinaria fulvula Flach, 1988	?
Albinaria hippolyti (Boettger, 1878)	?
Albinaria inflata (Olivier, 1801)	R?
Albinaria jonica (Pfeiffer, 1866)	?
Albinaria olivieri (Rossmassler)	?
Albinaria purpura Reitsma, 1988	?
Albinaria turrita (Pfeiffer)	?
endemic to the western arc of the Cyclades; occurs on many islands now severely disturbed e.g. Macronissos which is heavily overgrazed (Mylonas, 1984; Mylonas & Vardinoyannis, 1989)	
Albinaria ulrikae Schilthuizen & Gittenberger, 1990	?
Albinaria violacea Schilthuizen & Gittenberger, 1990	?
Albinaria wiesei Gittenberger, 1988	?
Sericata sericata (Pfeiffer, 1849)	R?
Family Enidae	
Mastus dirphicus (Blanc)	?
Mastus etuberculatus (Frauendfeld)	?
Mastus olivaceus (Pfeiffer)	?
Mastus pusio (Brod.)	?
Mastus turgidus (Kobelt)	?
Family Zonitidae	
Vitrea clessini (Hesse)	?
Vitrea keaana (Riedel & Mylonas)	?
Vitrea storchi Pinter, 1978	?
Zonites siphinicus (Fuchs & Kaufel)	?
Family Limacidae	
Deroceras cycladicum Wiktor & Mylonas	?
Deroceras keaansis Altena	?
Deroceras malkini Wiktor, 1984	?
Deroceras melinum Wiktor & Mylonas	?
Deroceras oertzeni (Simroth)	?
Deroceras parium Wiktor & Mylonas	?
Deroceras samium Rahle 1983	?
Deroceras seriphium Wiktor & Mylonas	?
Deroceras thersites (Simroth)	?
Family Helicidae	
Cernuella profuga (Schmidt)	?
Condrigtonia condrigtonia (Gray, 1834)	?
Helicigona cyclolabris (Deshayes)	?
Helicigona heldreichi Shuttleworth	?

Helicigona posthuma Knipper ?
Helix godetiana Kobelt V?
endemic to islands of central Aegean; not found on cultivated land and threatened by grazing; threatened on Thira (Santorini) by tourism and introduction of cable car (Mylonas, 1984; Butot in litt., 1990); protected.
Helix nucula ?
Monacha rothi (Pfeiffer, 1841) ?
Trochoidea cretica (Pfeiffer) ?
Trochoidea didyma (Westerlund) ?
Trochoidea siphnicus (Kobelt) ?
Family ??
Metafruticicola andria (Martens) ?
Metafruticicola grelloisii ?
Metafruticicola graphicotera (Bourguinat) ?
Metafruticicola pellita (Ferussac) ?
Metafruticicola naxiana (Ferussac) ?
Metafruticicola redtenbacheri (Zeleb) ?

HUNGARY
Family Hydrobiidae
Paladilhia hungarica Soos 1927 R

ITALY (list incomplete; Sicilian endemics included here; for Sardinia see below)
Family Cyclophoridae
Cochlostoma alleryanum (Paulucci, 1879) ?
Cochlostoma canestrini (Adami, 1876) ?
Cochlostoma gualfinense (de Stefani, 1879) ?
Cochlostoma paladilhianum (De Saint Simonon, 1878) ?
Cochlostoma philippianus (Pfeiffer, 1852) ?
Cochlostoma subalpinum (Pini, 1884) R
Cochlostoma turriculatum Philippi, 1836 ?
Cochlostoma villae (Strobel, 1851) ?
Cochlostoma westerlundi (Paulucci, 1879) ?
Family Hydrobiidae
Alzoniella feneriensis Giusti & Bodon, 1984 ?
Alzoniella finalina Giusti & Bodon, 1984 R?
Alzoniella sigestra Giusti & Bodon, 1984 ?
Arganiella pescei Giusti & Pezzoli, 1980 ?
Avenionia sp. ?
Avenionia ligustica Giusti & Bodon, 1981 ?
Avenionia parvula Giusti & Bodon, 1981 ?
Belgrandia bonelliana (de Stefani,1879) ?
Belgrandia minuscola (Paulucci, 1881) ?
Bythiospeum pezzoli (Boeters, 1971) ?
Bythiospeum vallei (Giusti & Pezzoli, 1976) R?
Bythiospeum virei (Locard, 1903) ?
Bythiospeum vobarnensis (Pezzoli & Toffoletto, 1968) ?
Heliobia aponensis (Martens, 1858) Ex?
Iglica ? tellinii (Pollonera, 1898) ?
Pauluccinella minima (Paulucci, 1881) ?
Pezzolia radapalladis (Bodon & Giusti, 1986) R?
Pezzolia sp. ?
Phreatica bolei Velkovrk, 1970 ?
Pseudamnicola lucensis (Issel, 1866) ?
Pseudamnicola moussoni (Calcara, 1844) ?

Family Aciculidae	
Acicula beneckei (Andreae, 1883)	?
Acicula benoiti (Bourguignat, 1864)	?
Renea gentilei (Pollonera, 1889)	R?
Family Ellobiidae	
Zospeum allegretti Conci, 1956	?
Zospeum alpinum?	?
Zospeum cariadeghense Allegretti, 1944	?
Zospeum galvagnii Conci, 1956	?
Zospeum globosum Kuscer, 1928	?
Zospeum spelaeum Rossmassler, 1839	?
Zospeum turriculatum Allegretti, 1944	?
Family Cochlicopidae	
Hypnophila emiliana (Benoit, 1857)	?
Hypnophila incerta (Benoit, 1857)	?
Family Pupillidae	
Argna ligustica (Pollonera, 1886)	?
Argna valsabina (Spinelli, 1891)	?
Solatopupa pallida (Rossmassler, 1842)	?
Spelaeodiscus hauffeni Schmidt, 1855	?
Family Orculidae	
Orcula spoliata (Rossmassler, 1837)	?
Family Clausiliidae	
Clausilia whateliana Kuster, 1847	?
Dilataria boettgeriana (Paulucci, 1878)	?
Family Arionidae	
Arion franciscoloi Boata, Bodon & Giusti, 1983	?
Ariunculus speziae Lessona, 1881	?
Family Limacidae	
Deroceras bisacchianum Bodon, Boato & Giusti 1982	?
Deroceras planarioides (Simroth, 1910)	?
Lehmannia caprai Giusti, 1968	?
Family Zonitidae	
Aegopinella graziadei (Boeckel, 1940)	?
Aegopinella cisalpina Riedel, 1983	?
Aegopis italicus (Kobelt, 1876)	?
Oxychilus adamii (Westerlund, 1886)	?
Oxychilus alicurensis (Benoit, 1857)	?
Oxychilus caninii (Benoit, 1843)	?
Oxychilus carotii (Paulucci, 1879)	?
Oxychilus denatale (Pfeiffer, 1856)	?
Oxychilus egadinensis Riedel, 1973	?
Oxychilus gardinii Manganelli, Bodon & Giusti in press	?
Oxychilus majori Westerlund, 1886	?
Oxychilus nortoni (Calcara, 1843)	?
Oxychilus oglasicola Giusti, 1968	?
Oxychilus pilula (Westerlund, 1886)	?
Oxychilus polygirus (Pollonera, 1885)	?
Oxychilus uziellii (issel, 1872)	?
Retinella stabilei (Pollonera, 1886)	R
Vitrea etrusca (Paulucci, 1878)	?
Vitrea minelli (Pinter & Giusti, 1983)	?
Vitrea trolli (A.J. Wagner, 1922)	?
Family Vitrinidae	
Phenacolimax blanci (Pollonera, 1884)	?
Vitrinobrachium baccetti Giusti & Mazzini, 1970	?
Vitrinobrachium tridentinum Forcart, 1956	?

Family Helicidae

Arianta stenzi (Rossmassler, 1835)	?
Candidula cavannai (Paulucci, 1881)	?
Candidula claudia (Sacchi, 1954)	?
Candidula fiorii (Alzona & Bisacchi, 1938)	?
Candidula grovesiana (Paulucci, 1881)	?
Candidula spadai (Calcara, 1845)	?
Carpathica stussineri (A.J. Wagner, 1895)	?
Cernuella hydruntina (Kobelt, 1884)	?
Cernuellopsis ghisottii Manganelli & Giusti, 1987	?
Chilostoma ambrosi (Strobel, 1851)	?
Ciliellopsis oglasae Giusti & Manganelli, 1990	R?
Drepanostoma cameranoi (Lessona, 1880)	?
Helicodonta calabrica Degner, 1927	?
Helicigona lefeburiana (Ferussac, 1882)	?
Helix mazzullii de Cristofori & Jan, 1832	?
Perforatella sp.	?
Schileykiella parlatoris (Bivona, 1839)	?
Schileykiella reinae (Pfeiffer, 1856)	?
Tacheocampylaea tacheoides Pollonera, 1909	V
Tyrrheniella josephi Giusti & Manganelli, 1989	R
Xeromunda cf durieui (Pfeiffer, 1848)	R?
Xeromunda turbinata (de Cristofori & Jan, 1832)	?

MADEIRA

c. 170 endemic species - see country table in Annex for full list and data sheet for 60-80 threatened endemics. N.B. this archipelago has largest number of endemic species in Europe

MALTA

Family Hydrobiidae

Pseudamnicola melitensis (Paladilhe, 1869)*	E

Family Clausiliidae

Lampedusa imitratix*	E/V
Lampedusa macrostoma*	E/nt

Family Agrolimacidae

Deroceras golcheri (Van regteren Altena, 1962)	nt

Family Helicidae

Marmorana melitensis (Ferussac, 18 2)	?

Family Hygromiidae

Cernuella caruanae (Kobelt, 1888)	nt
Trochoidea spratti*	E/nt
Trochoidea gharlapsi Beckmann, 1987*	V

POLAND (threatened species only)

Family Hydrobiidae

Bythiospeum neglectissimum Falniowski & Steffek 1989	E?

Family Helicidae

Helicigona cingulella Rossmassler, 1837	R/V
Helicigona rossmassleri Pfeiffer 1842	R/V

PORTUGAL (list incomplete - comments as for Spain, see below)

Family Helicidae

Candidula setubalensis Pfeiffer, 1858	I
Helix turriplana (Morelet)	V

ROMANIA (list incomplete)

Family Enidae	
Zebrina varnensis (Pfeiffer, 1847)	I?
Family Clausiliidae	
Alopia plumbea (Rossmassler 1839)	R?
Family Helicidae	
Soosia diodonta (Ferussac, 1821)	V

SALVAGE ISLANDS

Family Helicidae	
Theba macandrewiana (L. Pfeiffer, 1953)	?

SARDINIA (ITALY) (list incomplete)

Family Cyclophoridae	
Cochlostoma sardoum (Westerlund, 1890)	?
Family Hydrobiidae	
Mercuria zopissa (Paulucci, 1882)	?
Family Cochlicopidae	
Hypnophila bisacchii Giusti, 1970	?
Hypnophila dohrni (Paulucci, 1882)	?
Family Arionidae	
Arion isseli Lessona & Pollonera, 1882	?
Family Limacidae	
Deroceras dallaii Giusti, 1970	?
Deroceras sardoum (Simroth, 1886)	?
Family Zonitidae	
Oxychilus oppressus (fisher & Studer, 1878)	?
Vitrea petricola (Paulucci, 1882)	?
Family Vitrinidae	
Phenacolimax pollonerianus (Fra Piero, 1897)	?
Family Helicidae	
Nienhuisiella antonellae Giusti & Manganelli,1987	?
Tacheocampylaea carotti (Paulucci, 1882)	?

SPAIN

This list includes only a few of the many endemics; four in the genus *Candidula*, 13 *Pyrenaearia*, 4-6 *Cernuella*, and others in the genera *Ponentina*, *Oestophora*, *Oestophorella*. Many species are endemic to the Iberian peninsula e.g. 10 in genus *Trochoidea*, 18 in genus *Helicella*, all in genera *Iberus* and *Iberellus* (Aparicio *in litt.*, 14.2.91).

Family Cochlicopidae	
Hypnophila malagana Gittenberger & Menkhorst 1983	?
Family Pupillidae	
Chondrina ripkeni Gittenberger, 1973	?
Family Ferussacidae	
Cryptazeca vasconica (Kobelt, 1894)	?
Family Zonitidae	
Oxychilus basajauna Altonaga, 1990	R?
Family Helicidae	
Helicella mangae Gittenberger & Raven, 1982	?
Helicella orzai Gittenberger & Manga, 1981	?
Iberus alonensis (Ferussac, 1801)	?
Iberus campesinus (Ezq.)	R?
Iberus gualterianus (Linnaeus, 1758)	R?
Iberus marmoratus (Ferussac, 1801)	?
Montserratina bofilliana Fagot, 1884	?
Theba andalusica Gittenberger & Ripken, 1987	?

SWITZERLAND

Family Clausiliidae
Neostryiaca strobeli (Strobel, 1850) R?
Family Limacidae
Deroceras sp. 1 Wuthrich in prep ?
Family Milacidae
Tandonia nigra (Pfeiffer, 1894) ?
Family Helicidae
Trichia biconica (Eder, 1917) V
Bannalper Schonegg up to Chaiserstuel in canton of Nidwalden (2150-2400m); appears to be dependent on community of loose pioneer vegetation and sun-exposed slabs of limstone. Intensification of alpine farming or expansion of winter sports facilities could exterminate this species (Turner and Ruetschi, 1989; Kerney and Cameron, 1979).
Trichia caelata (Studer, 1820) S
Trichia clandestina (Hartmann, 1821) R
Trichia montana (Studer, 1820) R

USSR

Lake Baikal endemics = c. 55 species (see data sheet)
Caspian sea endemics = 41 species (brackish and freshwater spp.)
Other freshwater endemics = 30 spp.
Terrestrial endemics = 159 spp.

YUGOSLAVIA

There are a vast number of endemics in Yugoslavia; P. Reischutz (in litt., 23.2.91) has provided a provisional list,some of which may also occur in Albania. The c. 55 Lake Ohrid endemics = are described in a data sheet.

Family Valvatidae
Valvata = 4 species in L. Ohrid
Family Hydrobiidae
c. 40 species in L. Ohrid
Family Acroloxidae
3 species, 2 in L. Ohrid
Family Limneidae
2 species
Family Planorbidae
9 species, 6 in L. Ohrid
Family Ancylidae
3 species in L. Ohrid
Family Hydrocenidae
Hydrocena cattaroensis (L. Pfeiffer, 1841) ?
Family Cyclophoridae
Cochlostoma - 13 endemic species
Family Carychiidae
Zospeum = 9 species
Family Aciculidae
Platyla elisabethae (Pinter & Szigethy 1973) ?
Platyla maasseni Boeters, Gittenberger & Subai 1989 ?
Platyla procax Boeters, Gitternberger & Subai ?
Family Viviparidae
Viviparus mammillatus (Kuster, 1852) ?
Family Cochlicopidae
1 species
Family Orculidae
1 species

Family Pupillidae
    17 species
Family Enidae
    3 species
Family Zonitidae
    c. 34 species
Family Milacidae
    c. 10 species
Family Clausiliidae
    Agathyla c. 11 species
    Balea 1 species
    Bulgarica 3 species
    Carinigera c. 4 species
    Cochlodina c. 3 species
    Delima c. 17 species
    Euxinella radikae 1 species
    Herilla c. 3 species
    Macedonica c. 2 species
    Medora c. 11 species
    Montenegrina c. 6 species
    Protoherilla c. 3 species
    Triloba c. 2 species
Family Ferusaciidae
    c. 2 species
Family Helicidae
    Chilostoma c. 8 species
    Helix 1 species
    Monacha c. 2 species
    Trichia c. 3 species
    Vidovicia 1 species

CORSICA THREATENED ENDEMICS INDETERMINATE

Class	GASTROPODA	
Order	STYLOMMATOPHORA	
Family	COCHLICOPIDAE	Hypnophila remyi (Boettger, 1949)
Family	CHONDRINIDAE	Solatopupa guidoni guidoni (Caziot, 1903)
Family	HELICIDAE	Cyrnotheba corsica (Shuttleworth, 1843)
		Tacheocampylaea raspaili (Payraudeau, 1826)
		Helix ceratina Pfeiffer, 1843
Class	BIVALVIA	
Order	UNIONOIDA	
Family	UNIONIDAE	Unio turtoni Payreaudeau, 1826

Nomenclature Helix ceratina is commonly known as H. tristis; Hypnophila remyi also known as Azeca remyi; Cyrnotheba corsica also known as Monacha corsica; Solatopupa guidoni considered a variety of S. similis in the 1930s but now recognised as a separate species, but also called S. simonettae; some authors consider the subspecies of Tacheocampylaea raspaili to be separate species. Unio turtoni, also known as U. capigliolo, has been described by some authors as a subspecies of U. elongatulus.

Common names H. ceratina = Escargot de Corse; T. raspaili = Escargot de Raspail.

Biology H. ceratina is found in clumps of broom and in hot weather buries itself in granitic sand to 50 cm depth. T. raspaili is found in damp and shady habitats (Real and Testud, 1980).

Range Corsica

Status
The following species are considered at risk because of their small ranges (Bouchet, 1990);

COCHLICOPIDAE	
Hypnophila remyi	I; known only from the type locality, the grotto of i Paladini, in Solaro (Bouchet, 1990).
CHONDRINIDAE	
Solatopupa guidoni guidoni	I; known from the north: St Florent, Francaldo, Grotta di Sabara, Col. de Teghine, Mte Padro, Corte. 30-550m; S. guidoni simonettae occurs in Sardinia also (Bouchet, 1990; Boato, 1988)
HELICIDAE	
Cyrnotheba corsica	I; known from about twenty sites in the centre and north but never common; found in leaf litter, under stones and logs, in both coniferous and deciduous forest (Giusti and Manganelli, 1987; Bouchet, 1990).
Tacheocampylaea raspaili	I; rare, but widely distributed; recorded in error from Sardinia and Tuscany (Real and Real-Testud, 1983, 1988; Bouchet, 1990)
Helix ceratina	I; very rare; found in the meadows of the delta of the Gravone and the Prunelli near Ajaccio (Holyoak, 1983; Bouchet, 1990)
UNIONIDAE	
Unio turtoni	R; widespread ? but rare; very little information available.

Oxychilus tropidophorus, Cochlodina meisneriana, and Deroceras cazioti are also endemic to Corsica but have a wide distribution and are not considered threatened (Bouchet, 1990).

Conservation

Helix ceratina and Tacheocampylaea raspaili are protected under a French ministerial decree of 1979, which prohibits collection. The other threatened species are recommended for protection and appropriate sites should be designated as Zones Naturelles d'Interet Ecologique, Faunistique et Floristique (Bouchet, 1990).

Identification

Bibliography Real and Testud (1988).

GIBRALTAR THREATENED ENDEMICS RARE/INDETERMINATE

Class	GASTROPODA	
Order	MESOGASTROPODA	
Family	ACICULIDAE	Acicula norrisi Gittenberger & Boeters, 1977
Order	STYLOMMATOPHORA	
Family	FERUSSACIDAE	Cecilioides spp
Family	HELICIDAE	Osteophora calpeana (Morelet, 1854)

Nomenclature A. norrisi previously described as Acme ? n.sp. (Ponsonby, 1885). The taxonomy of Cecilioides on Gibraltar needs further work, but there may be three species, one of which C. connollyi Tomlin, 1943 is endemic (Menez in litt. 1990). O. calpeana was described in Norris (1976) as Caracollina calpeana (Morelet, 1854).

Common names

Biology
A. norrisi is found in soil on limestone rocks, in scree and steppe, often where Acanthurus mollis L. is growing. The Cecilioides snails are found under rocks in steppe and low maquis. O. calpeana occurs on and under rocks in steppe and low maquis, occasionally 1-2m from ground on larger rocks (Menez in litt., 1990).

Range
Gibraltar.

Status
Demand for land and building materials, as a result of the limited area of Gibraltar, threatens several of the indigenous molluscs. The endemic species are particularly vulnerable (Menez in litt., 1990; Norris, 1976).

A. norrisi	R; Windmill Hill Flats, Mediterranean Steps, Upper Rock. Few shell specimens and the species have never been collected alive, but fresh shells indicate that live individuals are present (Menez in litt., 1990; Gittenberger and Boeter, 1977; Norris, 1976).
Cecilioides spp.	I; this genus is found in the Europa Pt area, on Windmill Hill Flats, Mediterranean Steps and the Upper Rock (Menez in litt., 1990). If the presence of endemic species is confirmed, these would be at risk from their small distribution.
O. calpeana	I; slopes around Little Bay, Europa Pt area, Mediterranean Steps and Upper Rock (Menez in litt., 1990; Norris, 1976).

Conservation
All three taxa are included in the new Endangered Species (Import & Export) Ordinance of 1990, which restricts trade. They will also be covered by the Nature Conservation Ordinance 1991, which is being drafted, and which will control collection and provide for the declaration of protected areas (Cortes in litt. 3.11.90).

The threatened endemics occur within a number of sites, currently belonging to the Ministry of Defence, that have been identified as of importance for their mollusc populations:

The Upper Rock, including part of Mediterranean Steps, (A. norrisi, O. calpeana and also Pyramidula rupestris (I), Chondrina calpica (I), Granopupa granum (I) and Lauria cylindracea (R)), has been earmarked for National Park status under the proposed Nature Conservation Ordinance (Cortes in litt.,

3.11.90); it also has a unique plant community including endemic species, an important resident bird community and is important for migratory birds (Cortes, 1990).

Windmill Hill Flats (O. calpeana, A. norrisi, Cecilioides spp., and also L. cylindracea (R), and Chondrina calpica (I)) is a Ministry of Defence (M.O.D.) Conservation area but may come under threat from development if it is transferred to the Gibraltar Government (Menez, in litt. 1990); it is one of the most important wildlife zones in Gibraltar, particularly for migratory birds, endemic plants and the Barbary partridge Alectoris barbara (Cortes, 1990).

Europa Pt (O. calpeana, Cecilioides spp and also Oxychilus draparnaudi (K)) is M.O.D. land but may come under threat if transferred to the Gibraltar Government (Menez in litt., 1990). **Mediterranean Steps** (A. norrisi, O. calpeana and also L. cylindracea (R)) is M.O.D. land but is unlikely to be developed. **Little Bay slopes** (O. calpeana, and also Oxychilus draparnaudi (K), Candidula intersecta (i) and Trichia hispida (R)) is threatened by development.

MADEIRA THREATENED ENDEMICS

			THREATENED
Class	GASTROPODA		
Order	MESOGASTROPODA	Family CYCLOPHORIDAE	2 spp.
Order	STYLOMMATOPHORA	Family PUPILLIDAE	15 spp.
		Family CLAUSILIIDAE	2 spp.
		Family FERUSSACIIDAE	6 spp.
		Family ENDODONTIDAE	1 spp.
		Family HELICIDAE	39 spp.

Nomenclature There is still considerable confusion in the taxonomy of the Madeiran molluscs; this data sheet is based largely on the species list in Walden (1983). More recent work has been carried out on the genera Boettgeria and Phenacolimax; work is underway on Deroceras, Craspedoma and Actinella and Walden is carrying out a substantial revision of the fauna. D. defloratus Lowe, 1854 (listed as Vulnerable in the IUCN Invertebrate Red Data Book) is now recognised as being a misidentified specimen of Trichia striolata (Pfeiffer) (not threatened).

Common names

Biology
The endemic molluscs are found either in the moist north forests or the dry short vegetation of the south. Snails are generally absent from the coniferous plantations. Habitats on Porto Santo and the Desertas islands are mainly dry and stony with thin soil and vegetation cover (Wells et al., 1983). Several of the presumed extinct species and threatened species are are confined to damp laurel woodland. Many of the threatened species occur in dry open habitats. Others have more specialised lifestyles such as flushed, mossy precipices or rocky terrain (Walden, in press).

(N.B. In the following text, all figures and percentages must be considered approximations because of lack of certainty in the taxonomy of the species concerned.)

Range:
The Madeiran archipelago consists of seven islands, all within 30 km of each other and divided into three groups: Madeira itself, Porto Santo and its offshore islets, and the three Deserta Islands. Of the 194 land gastropods that have been described from the islands, 171 are endemic to the archipelago. Only 30-40 species occur in Europe and North Africa and only seven on any of the other Atlantic islands (Walden, 1983, in press).

The majority of the endemic group are helicids, and even within the islands these tend to be rare and have restricted distributions. Only three species (Discula polymorpha, Heterostoma paupercula and Boettgeria deltostoma) are present on all three island groups and most of the rest occur on one or two groups only. Using the species listed in Wollaston (1878), Madeira has 96 species, Porto Santo 57, Baixo 14, Cima 17, Deserta Grande 23, Bugio 27 and Chao 9 (recent taxonomic work will alter these figures, but they give some idea of the relative diversity of each island). Each island group has its own characteristic species. Ponta do Garajau on Madeira probably supports the most diverse molluscan fauna (Cook et al., 1972).

Status
Over 60 (c. 36%) of the 171 endemic molluscs on Madeira are considered threatened. Of these, about 17 have not been seen for 100 years despite the collecting efforts of many workers throughout this period; these species may now be extinct although there has been at least one re-discovery, Idiomela subplicata (Hemmen and Groh, 1984). 21 species are very rare and are restricted to single populations or small areas (Endangered and Vulnerable

below). In general species are not abundant at any one site (Seddon, pers. comm.). A further 23 endemic species are categorised as rare (Walden, in press). Boettgeria is an endemic genus (Groh and Hemmen, 1984).

All the habitats of the endemic molluscs of the Madeiran archipelago are threatened by development and/or erosion. The volcanic soils are very fragile and erode rapidly after mechanical disturbance or when the vegetation is removed. Such areas used to support an endemic low scrub cover, much of which has now gone because of over-grazing by introduced cattle, sheep, goats and rabbits. Since many of the endemics occur in single populations or have very small ranges, even small scale developments could result in extinctions (Wells et al.. 1983).

The most threatened areas are Porto Santo (growing tourism and ?Nato base) and the south coast, particularly Garajau which is the main area of expansion for Funchal (Bramwell in litt., 1982). The dry coastal habitats preferred by many snails are threatened by tourist developments. Ponta de Sao Lourenco is largely uninhabited but is heavily grazed with few trees and very arid; the peninsula has a distinctive fauna with numerous endemics that have been extensively studied. Amphorella iridescens and A. tornatellina minor (possibly a full species) are found only on the peninsula and other species have the main part of their populations there. These do badly in disturbed sites. The area around Canical is very disturbed and snails are now hard to find among the alien vegetation and frequent signs of burning and coppicing. There are a few patches of relict sites. An important fossil-bearing sand deposit is being destroyed at Ponta de Sao Lourenco through excavation for building sand and erosion into the sea (Cook et al., 1990).

Destruction of the laurisilva is a major threat, and only 13.6% of the island is now forested. Most was destroyed in the centuries immediately following human settlement, as early as 1500 A.D., and many species probably disappeared before scientific work started in the 19th century. Other threats include military activities and industrial development (Walden, in press). The Porto Santo species seem to be particularly at risk; there is a particularly high endemism for the size of the island and most of the species are now restricted to the remaining hill top forest. Planting of Pinus alepensis is a major threat to the endemic invertebrates; much of Porto Santo is covered in grassland and, although not natural vegetation, this provides a better habitat than introduced conifers (Seddon pers. comm. 1990; Read and Wheater in prep.). Endemic snails are also collected by commercial land snail collectors (Macedo, 1990) although the extent to which this represents a threat is not known.

The following list is incomplete for distribution data, but gives an idea of the number of threatened endemics. Information is taken from Walden (in press), Wells et al. (1983) and Seddon (pers. comm., 1990). Categories in brackets are those from the IUCN Invertebrate Red Data Book (Wells et al., 1983). The non-threatened endemics are listed in the country table for Madeira (see Annex).

CYCLOPHORIDAE	
Craspedopoma lyonnetianum (Lowe 1852)	R; humid laurel woods
C. trochoideum Lowe, 1860	R; cool laurisilva
PUPILLIDAE	
Lauria fanalensis(Lowe, 1852)	E/Ex; laurisilva
Leiostyla abbreviata (Lowe, 1852)	Ex?(V); laurisilva; rare on Madeira as early as 1878.
L. cassida (Lowe, 1831)	Ex?(V); found in laurisilva, ravines at intermediate alts; Ribeira de Santa Luzia on south Madeira and Ribeira de Sao Jorge in the north. Uncommon by 1878, although abundant in subfossil form at Canical.

L. cheilogona Lowe 1831	Ex?; restricted to small area; not seen this century
L. concinna (Lowe, 1852)	Ex?; laurisilva - not seen this century
L. corneocostata (Wollaston, 1878)	E(V); dry stony habitats; Porto Santo, Pta Calheta.
L. degenerata (Wollaston, 1878)	Ex?; laurisilva
L. ferraria (Lowe, 1852)	R; hilly crags; known from 2 sites only.
L. filicum Holyoak & Seddon, 1986	V/R; moist laurel forest
L. gibba (Lowe, 1852)	Ex?(V); laurisilva, loose plant detritus; Ribeira de Santa Luzia, south Madeira. Rare by 1878 but abundant in subfossil beds at Canical.
L. heterodon (Pilsbry, 1923)	Ex?; laurisilva
L. laevigata (Lowe, 1852)	Ex; laurisilva
L. lamellosa (Lowe, 1852)	Ex?(V); laurisilva, intermediate altitudes; recorded only in south Madeira at intermediate altitudes in the Vasco Gil ravine and the Ribeira de Santa Luzia; one of the rarest snails in 1878.
L. laurinea (Lowe, 1852)	R; laurisilva
L. monticola (Lowe, 1831)	V/E; woodland on hilltops
L. relevata (Wollaston, 1878)	R; dry stony ground; island off Porto Santo.
L. simulator (Pilsbry, 1923)	Ex?; laurisilva
L. vincta (Lowe, 1852)	R; moist crags; locally common on north coast.
CLAUSILIIDAE	
Boettgeria crispa (Lowe, 1831)	R; laurisilva; Madeira (Ribeiro Frio, Santo da Serra)
B. obesiuscula (Lowe, 1863)	R; dry stony ground; south-east Madeira
FERUSSACIIDAE	
Amphorella iridescens (Wollaston, 1878)	Ex?; dry stony ground
A. melampoides (Lowe, 1831)	R; dry stony ground
A. producta(Lowe, 1852)	R; dry stony ground
Cecilioides eulima(Lowe, 1854)	Ex?
C. nyctelia (Bourguignat, 1856)	K
Cylichnidia ovuliformis (Lowe, 1831)	V; laurisilva
ENDODONTIDAE	
Discus guerinianus (Lowe, 1852)	Ex?(V); Confined to damp wooded areas of Madeira at high and intermediate altitudes in interior of island. Rare by 1878.
HELICIDAE	
Actinella actinophora (Lowe, 1831)	V; laurisilva
A. anaglyptica (Reeve, 1852)	R; dry stony ground
A. armitageana (Lowe, 1852)	V
A. carinofausta	R
A. effugiens (Walden, 1983)	E; dry stony ground
A. giramica (Lowe, 1852)	V; laurisilva
A. laciniosa (Lowe, 1852)	R; dry stony ground; north of Ilheu Chao
A. robusta (Wollaston, 1878)	E; dry stony
A. obserata (Lowe, 1852)	V; laurisilva
Caseolus calculus (Lowe, 1854)	V(V); dry stony ground; Ilheu de Cima; Pico d'Anna Ferreira and Pico Branco, Porto Santo. Rare by 1848.

C. commixtus (Lowe, 1854)	R(V); Ilheu de Baixo, Porto Santo
C. leptostictus (Lowe, 1831)	V; dry stony ground; S. Goncale, Garajau, Canico, Agua de Pena.
C. sphaerulus (Lowe,1852)	E?(V); Pico Branco, Porto Santo.
C. subcalliferous (Reeve, 1854)	V; Pico Branco, Porto Santo (?subfossil)
Discula cheiranticola (Lowe, 1931)	R
D. leacockiana (Wollaston, 1878)	R(V); Pico d'Anna Ferreira, Porto Santo
D. lyelliana (Lowe, 1852)	Ex?; dry stony ground
D. oxytropis (Lowe, 1831)	V; dry stony ground
D. tabellata (Lowe, 1852)	V(V); Dry maritime slopes of Ponta Garajau, south Madeira; Cabo Girao, west of Funchal.
D. tectiformis (Sowerby, 1824)	R; dry stony ground
D. testudinalis (Lowe, 1852)	V(V); dry stony ground; Pedragal, north Porto Santo; area of c. 10 sq m. only.
D. tetrica (Lowe, 1862)	Ex?; dry stony ground
D. turricula (Lowe, 1831)	V(V); Endemic to Ilheu de Cima, under large basaltic rocks.
Disculella spirulina Cockerell, 1921	V; dry stony ground
Geomitra delphinuloides (Lowe, 1860)	Ex?; 19th century records only; small area on Madeira
G. moniziana (Paiva, 1867)	R(V); Gaula and Canico in south-east Madeira; Ribeiro de Porto Nova; San Vicente.
G. tiarella (Webb & Berthelot, 1833)	V; dry and stony; Sao Vincente, Ribiero do Inferno
Geomitra sp. nov.	V; dry and stony
Idiomela subplicata (Sowerby, 1824)	V(V); recorded from Ilheu de Baixo in 1878; subfossil forms only found in 1930s; rediscovered in early 1980s (Hemmen & Groh, 1984).
Lampadia webbiana (Lowe, 1831)	V
Lemniscia calva (Lowe 1831)	R
L. galeata (Lowe, 1862)	Ex?; laurisilva
Leptaxis furva (Lowe, 1831)	R; laurisilva
L. portosancti (Lowe)	V; laurisilva (? subsp. of L. erubescens)
L. wollastoni (Lowe, 1852)	E
Pseudocampylaea lowei (Ferussac, 1835)	Ex?
Spirorbula latens (Lowe, 1852)	R
S. squalida (Lowe, 1852)	R

Seddon (pers. comm., 1990) and Cameron (in litt., 13.5.91) have also expressed concern for the long term survival of the following species and suggested categories: Leiostyla calthiscus (Lowe, 1831) (V/E), L. fusca (Lowe, 1852) (E/V), Janulus stephanophora (R), Actinella fausta (E), Caseolus abjectus (R), C. consors (R), C. hartungi (R), Discula bicarinata (R), D. bulweri (R; rodents a threat), D. echinulata (R), D. maderensis (R), Lemniscia michaudi (Deshayes, 1830) (R/V), Leptaxis erubescens (R), L. membranacea (Lowe, 1852) (R), Pseudocampylaea portosanctana (R), Spirorbula obtecta (R).

Conservation

No measures have been taken specifically for molluscs. The Parque Natural da Madeira was established in 1982. This comprises five Strict Reserves, including two of the main laurisilva areas (Montado dos Pesseguieros and

Caldeirao Verde), three Partial Reserves (including Ponta de Sao Lourenco), six Protected Landscapes, five Recreation reserves and four 'areas of leisure and silence' (Biscoito, n.d.). Recommendations for development and protection of Ponta de Sao Lourenco, in the context of tourism and recreation, have been drawn up by Ferriera (1991). Laurisilva on the north side of Madeira is protected by decree. A proposal has been drawn up for legislation to protect all endemic species including molluscs (Abreu, 1990).

The Desertas are privately owned and the endemics are thought to be relatively safe (Seddon pers. comm. 1990) but there is a proposal to protect them and Porto Santo (Biscoito n.d.).

Sixteen endemic species are listed on Appendix II of the Bern Convention: Leiostyla abbreviata, L. cassida, L. corneocostata, L. gibba, L. lamellosa, Caseolus calculus, C. commixta, C. sphaerula, Discula leacockiana, D. tabellata, D. testudinalis, D. turricula, Geomitra moniziana, Helix subplicata (now Idiomela subplicata), Discus defloratus (no longer a valid species), D. guerinianus. These species are also listed in the IUCN Invertebrate Red Data Book (Wells et al., 1983) and the IUCN Red List (IUCN, 1990), and have been proposed for listing on the EEC Habitats Directive and the UNECE Red List. Whether additional species should be listed requires further consideration.

Further work is urgently required to determine the status of the threatened endemics in more detail and to integrate conservation measures for molluscs with other initiatives in the archipelago. Reserve management should aim to provide suitable conditions for species sensitive to environmental change, as might be caused by tourism (Walden, in press).

MALTA THREATENED ENDEMICS **ENDANGERED/VULNERABLE**

Class	GASTROPODA	
Order	MESOGASTROPODA	
Family	HYDROBIIDAE	Pseudamnicola melitensis (Paladilhe, 1869)
Order	STYLOMMATOPHORA	
Family	CLAUSILIIDAE	Lampedusa imitatrix imitatrix (Boettger, 1878)
		L. imitatrix melitensis (Caruana-Gatto, 1878)
		L. imitatrix gattoi Soos, 1933
		L. macrostoma scalaris (Pfeiffer, 1850)
		L. macrostoma mamotica (Gulia, 1861)
Family	HYGROMIIDAE	Trochoidea spratti spratti (Pfeiffer, 1841)
		T. spratti cucullus (Martens, 1873)
		T. spratti despotti (Soos, 1933)
		T. gharlapsi Beckmann, 1987

Nomenclature The genera Lampedusa and Trochoidea occur on the archipelago as a complex mosaic of species, subspecies, hybrid forms and ecotypes, mostly endemic to the small area they occupy. Many taxa were originally described on the basis of shell morphology only. Anatomical studies of soft parts and more recently, genetic studies,have resulted in a reappraisal of many species and the recognition of new ones, and a major re-examination of these taxa is now underway. Nomenclature is therefore still very confused; the issue is complicated by the lack of information on the malacofauna of other central Mediterranean islands and north Africa (Thake and Schembri, 1989; Schembri in litt., 20.8.90). This data sheet uses the taxonomy adopted in the Red Data Book for the Maltese Islands which is based on preliminary work by Giusti and co-workers. We have included several subspecies as some workers believe that these may yet prove to be full species; the importance of these populations for studying the biogeography of the islands and for studying evolutionary processes at work means that there is a strong case for their protection regardless of their taxonomic level. Further details on taxonomy are given in the note below.

Common names Snails in the family Clausiliidae are known as Door Snails; the Maltese name 'dussies' (=spindle) has been suggested. Pseudamnicola melitensis is a Spire-snail, known in Malta as Bebbux ta' l-Ilma (= water snail). The Trochoidea snails are Top Snails, known in Malta as Zugraga (= top).

Biology
Pseudamnicola melitensis is restricted to valleys draining more or less permanent springs. The threatened clausiliids and hygromiids are all found in karstland and on limestone coastal cliffs (Thake and Schembri, 1989). The clausiliids Lampedusa spp.are almost exclusively rock-dwelling, and are strongly associated with karst communities although some are also found in dry stone walls around cultivated fields. They are commonest on well-eroded karst and on escarpments, particularly on the Upper and Lower Coralline limestones. The clausiliids all aestivate between May and October, usually in cavities or fissures in the rock, although L. m. mamotica also often aestivates on bare rock faces, while gattoi does so under loose stones. There are few records of mating but this seems to take place in the autumn after the start of the cool wet season. The eggs are laid in shallow moist soil (Thake, 1985).

Range Maltese islands.

Status
Three endemic species (Pseudamnicola melitensis, Lampedusa imitatrix (with 3 subspecies) and Trochoidea gharlapsi) and five additional endemic subspecies

are Endangered or Vulnerable in the archipelago, primarily as a result of their very small ranges combined with intense development pressures on these heavily populated islands. Recent information from Beckmann (in litt., 1991) suggests that an endemic hydrobiid Mercuria kobelti (Westerlund, 1892) is also endangered. There are a further four endemic taxa that are not thought to be at risk; in addition there are three taxa that are at risk and may prove to be endemic following further taxonomic work (Cecilioides sp., cf. Hohenwartiana sp., Testacella sp.) (Thake and Schembri, 1989); these are not considered further in this data sheet.

Pseudamnicola melitensis	E; Malta and Gozo; absent from smaller islands; threatened by scarcity of suitable habitat and continuing disruption of such sites (Thake and Schembri, 1989).
Lampedusa imitatrix imitatrix	V; western Malta only (Thake, 1985); a large part of its former range is now covered with soil as part of a land reclamation project (Thake and Schembri, 1989).
L. imitatrix melitensis	E; known only from a single small site at the foot of a cliff at Rdum Dikkiena (Dingli Cliffs), Malta (Thake, 1985); population numbers about a few hundred individuals in an area of a few tens of sq m only. Probably the most endangered endemic species in the island (Thake and Schembri, 1989) but the site is relatively remote and inaccesible.
L. imitatrix gattoi	E; known only from Filfla (Thake, 1985) and only very few individuals have been seen alive recently; population was thought to number about 300 individuals; reason for decline not known (Thake and Schembri, 1989).
L. macrostoma scalaris	E; known only from a small area of a few hundred sq m at Ras il-Mignuna, on the north coast of Mistra Bay (Thake, 1985; Thake and Schembri, 1989) which is potentially attractive for development.
L. macrostoma mamotica	E; known only from Il-Fekruna in Xlendi Valley on Gozo. Building has already eliminated it from a considerable area of its former range. Several similar looking populations occur in Malta, the most important of which is at Ta'Mattew where it is threatened by building (Thake & Schembri, 1989); one of the most seriously threatened endemic as building is still occurring in its small range.
Trochoidea spratti spratti	R; widespread, occurring on all main islands and most of the smaller ones, but some populations with distinct phenotypes occupy very small areas and should be categorised as Rare, as they are threatened by habitat destruction (Thake and Schembri, 1989).
T. spratti cucullus	E; known from the mouth of the Wied Migra Ferha at Mtahleb (Malta), where half the area is covered by a carpark; populations with similar characters also occur on Gozo, at Il-Hotba tal-Qasam, Tal-Bardan, and Xlendi Bay (Thake and Schembri, 1989); remaining area still threatened by development.
T. spratti despotti	V; known only from Filfla Islet, where it occurs in a very small population (Thake and Schembri, 1989).
T. gharlapsi	V; known only from between Ghar Lapsi and Ras Hanzir on Malta and Xlendi Bay on Gozo; at risk because of small population size (Thake and Schembri, 1989).

Conservation

All the threatened taxa are listed in the Red Data Book for the Maltese Islands (Thake and Schembri, 1989). Lampedusa imitatrix gattoi and Trochoidea spratti despotti both occur within the Filfla Nature Reserve

where all wildlife is protected; these are the only taxa to be fully protected in this way. The three sites were L. macrostoma mamotica, L. macrostoma scalaris and Troichoidea spratti cucullus occur need to be declared protected areas urgently. The Maltese Parliament is currently considering a comprehensive bill on environmental protection which may include legal protection for certain threatened species; it is hoped that all threatened endemic molluscs will be included on the protected list. A Structure Plan for the islands is being drawn up and may designate sites with scientifically important species and habitats as 'Sites of Scientific Importance" (SSIs); these would be protected from development and other damaging activities. Most sites with threatened endemic molluscs have already been proposed as candidate SSIs (Schembri in litt., 6.12.90).

Identification Beckmann (1987).

Bibliography Thake and Schembri (1989); catalogue and bibliography in preparation (Beckmann, in prep.).

Further taxonomic note:
The main taxonomic problems lie with the genera Lampedusa and Trochoidea. Soos (1933) placed the Maltese Lampedusa taxa into two subgenera: Imitatrix and Muticaria; within the latter he recognised the species oscitans, mamotica, syracusana and scalaris. Holyoak (1986) placed the Muticaria species within Lampedusa as subspecies of L. syracusana. Beckmann and Gittenberger (1987) consider the Maltese populations of L. syracusana to be a separate species from Sicilian populations and have referred the Maltese populations to L. macrostoma, with three subspecies: macrostoma, oscitans, scalaris and mamotica.

One endemic species and three endemic subspecies of Trochoidea have been recognised in this data sheet. Beckmann (1987 and 1989) considers that there are eight species of Trochoidea, of which seven are endemic: calcarata, schembrii, oxygiaca, spratti, cucullus, despotti and gharlapsi. This system was not used in Thake and Schembri (1989) as recent studies are showing that intermediate forms between some of these forms can be found.

The species list given in Mandahl-Barth (1988) is considered to be inaccurate and is not generally used. Beckmann (in prep.) is preparing a catalogue of the non-marine mollusc fauna. A major revision of the this group, based on anatomical and genetic characters, has been carried out by Giusti, Manganelli and Schembri and is currently being prepared for publication.

TENERIFE THREATENED ENDEMICS THREATENED

Class	GASTROPODA			
Order	MESOGASTROPODA	Family	POMATIASIDAE	1 sp.
Order	BASOMMATOPHORA	Family	PLANORBIDAE	1 sp.
Order	STYLOMMATOPHORA	Families	ENIDAE	5 spp.
			ENDODONTIDAE	2 spp.
			VITRINIDAE	2 spp.
			PARMACELLIDAE	1 sp.
			LIMACIDAE	1 sp.
			HYGROMIIDAE	3 spp.
			HELICIDAE	8 spp.

Nomenclature see recent revision by Alonso et al. (in press a).

Common names

Biology
Many of the endemic molluscs of Tenerife (and of the Canary Islands as a whole) are restricted to the unique ecological communities found in the archipelago. Four zones are usually recognised (Ashmole and Ashmole, 1989): 1) Xeric lowland. This includes regions from sea level to 500m, or the lower edge of the forest, with low annual rainfall; it includes large areas of exposed rock, volcanic cinders and dust and is typified by many endemic plants including euphorbias of 'tabaiba'. 2) Laurel forest (Monteverde). This is found on north-facing slopes from a few hundred metres above sea level to the lower parts of the central ridge, but is now confined largely to the higher parts of the Anaga and Teno peninsulas and a few central areas. It consists of two vegetation types, laurisilva, which comprises some 15 species of laurel and laurel-like trees, and fayal-brezal which is dominated by the tree heath Erica arboracea and the tree Myrica faya. Many of the endemic molluscs are restricted to the laurisilva. 3) Pine forest (Pinar). This occurs mainly above 800m and extends up to 2200m; the endemic Canary Pine Pinus canariensis was previously dominant but several pine species have been introduced. 4) High mountain zone. This is a very barren area with lava, cinders and endemic shrubs and plants; fewer molluscs are found here. Further information on vegetation is given in Garcia et al. (1990) and Ceballos and Ortuno (1976).

Range Tenerife, Canary Islands

Status
Out of a total of about 200 non-marine molluscs on the Canary Islands, about 160 endemic species have been described (Alonso and Ibanez, in litt. 10.7.90). The taxonomy is still confused; Walden (1983) gives a total of 141 endemics out of 180 species. The Tenerife species have recently been revised and their distributions are mapped in Alonso et al. (in press a). Categories for the 24 threatened species listed below are given in Alonso et al. (in press b). A further twenty endemic species in Tenerife are considered 'not threatened'.

As mentioned above, the endemic species are largely restricted to native vegetation which has disappeared from much of the island. The native pine and laurel has been cut for timber, firewood, charcoal, pitch and tannins in the past. The pines are still harvested and their needles are removed for cattle bedding and mulch or as a fire precaution, thus removing the forest floor habitat. Agriculture has increased greatly in recent years, with the establishment of greenhouses for market garden produce. Prickly Pear, cultivated for its fruit and the Cochineal Bug that lives on it, is now spreading through the arid zone. Perhaps the current most serious threat is urbanization and the expansion of the tourist industry, which is now one of the main sources of income on the island (Ashmole and Ashmole, 1989).

POMATIASIDAE	
Pomatias raricosta (Wollaston, 1878)	V; xeric lowland, coastal; n. part of massif of Anaga
PLANORBIDAE	
Nautilinus clymene (Shuttleworth, 1852)	R; laurisilva
ENIDAE	
Napaeus badiosus (Ferussac, 1821)	V; xeric lowland, 150-500m; south-east
N. nanodes (Shuttleworth, 1852)	R; xeric lowland & laurisilva; south
N. propinquus (Shuttleworth, 1852)	R; xeric lowland, 750m; south: Barranco de Las Galgas
N. roccellicola (Webb & Berthelot, 1833)	V; rocks, 100-200m; Punta de Teno; threatened by agricultural expansion
N. variatus (Webb & Berthelot, 1833)	V; lowland; north of Anaga & Teno
ENDODONTIDAE	
Discus engonata (Shuttleworth, 1852)	R; under stones and dead wood; Garachico
D. scutula (Shuttleworth, 1852)	R; pines, 500-1100m; north-east
VITRINIDAE	
Insulivitrina mascaensis Morales, 1987	R; lowland; extreme west
Insulivitrina reticulata (Mousson, 1872)	E; xeric lowland; found only on the north side of Cabezo de las Mesas, about 300 m from the Centro Emisor del Atlantico.
PARMACELLIDAE	
Parmacella tenerifensis Alonso, Ibanez & Diaz, 1985	V; agricultural land, 560m; north-east, nr Rodeos, around La Laguna; threatened by agricultural development.
LIMACIDAE	
Malacolimax wiktori Alonso & Ibanez, 1989	V; agricultural land and lowland, 400-560m; between La Laguna, Geneto & Tegueste; threatened by agricultural development.
HYGROMIIDAE	
Canariella fortunata (Shuttleworth, 1852)	V; xeric lowland, below 400m; east threatened by development
C. leprosa (Shuttleworth, 1852)	V; laurisilva, 500-800m; north of Anaga
C. pthonera (Mabille, 1883)	V; laurisilva; north-west
HELICIDAE	
Hemicycla adansoni (Webb & Berthelot, 1833)	V; lowland, under rocks, ravines, in teasel and tabaiba; very restricted area in north-east, between Santa Cruz & Igueste de San Andres; threatened by urban development and constrution in the ravines around the port.
H. glyceia (Mabille, 1882)	V; laurisilva; H.g. silensis still occurs in the east; H. g. glyceia is extinct.
H. inutilis (Mousson, 1872)	V; often in 'malpaisas' under large rocks or in roots of bushes; east coast
H. mascaensis Alonso & Ibanez, 1988	V; lowland with endemic Euphorbia and Aeonium under rocks or buried by aloes; restricted distribution between Masca and Acantilado de los Gigantes; threatened by tourism development.
H. modesta (Ferussac, 1821)	E; xeric lowland; around Santa Cruz; threatened by urban development.

H. plicaria (Lamarck, 1816)	E; xeric lowland, in rocks and wall crevices around abandoned fields, in high temperatures; very restricted distribution on east coast; original range much reduced by urban development between Las Caletillas and Candelaria (type species of genus).
H. pouchet (Ferrusac, 1821)	V; varied habitats including lowland, herbaceous plants, xeric bushes especially tabaibas (Euphorbia); east; threatened by development.
Xerotricha nubivaga (Mabille, 1882)	R; under stones & high mountain brushwood, 1900-2300m, with wide daily temperature fluctuations; Canadas del Teide and surroundings (Gittenberger et al., 1989).

Conservation

Since 1987, a project has been underway with funding from the Direccion General de Medio Ambiente to catalogue the endemic molluscs of the Canary Islands for the purposes of conservation. Work has so far been carried out for Tenerife (Alonso et al., in press b).

There are 26 protected areas, classified as National Parks, Natural Park or Natural Space. The following molluscs occur within these areas (Alonso et al., in press b): Pomatias raricosta, Malacolimax wiktori, Canariella leprosa, Hemicycla adansoni: Parque Natural Anaga; Napaeus badiosus: Parques Naturales Anaga and Laderas de Santa Ursula, Los Organos and high part of the Guimar valley; N. nanodes: Parques Naturales Laderas de Santa Ursula, Los Organos and the Guimar valley; Napaeus roccellicola, Insulivitrina mascaensis, Canariella pthonera, Hemicycla mascaensis, H. glyceia silensis: Parque Natural Teno; N. variatus: Parques Naturales Anaga and Teno; Discus scutula: Parques Naturales Anaga and Corona Forestal; Xerotricha nubivaga Parque Nacional Canadas de Teide and Parque Natural Corona Forestal; Hemicycla inutilis: Parque Natural Laderas de Santa Ursula, Los Organos and the Guimar valley, Parajes Naturales Barranco de Herques and Malpais de Guimar.

The following threatened species do not occur in any protected areas: N. propinquus, Insulivitrina reticulata, Parmacella tenerifensis, Canariella fortunata, Hemicycla plicaria, H. pouchet, H. modesta.

Alonso et al. (in press, b) give recommendations for protection of the endemic malacofauna of Tenerife. Management plans for the existing protected areas should be fully implemented, and the parks of Anaga and Teno should receive priority as 72.7% of the Tenerife endemic molluscs are found within these areas. Protected areas should be established for those species that are not yet protected. All the endemic species (including those not yet considered threatened) should be listed as 'protected species'. Several are listed on the IUCN Red List (IUCN, 1990) and on the proposed UNECE list (see 'Conservation' section).

Identification

LAKE BAIKAL ENDEMICS			THREATENED
Class	GASTROPODA		
Order	MESOGASTROPODA	Family PLANORBIDAE	7 spp.
		Family ANCYLIDAE	3 spp.
		Family VALVATIDAE	4 spp.
		Family HYDROBIIDAE	7 spp.
		Family BAICALIIDAE	32 spp.
Class	BIVALVIA		
Order	VENEROIDA	Family SPHAERIIDAE	3 spp.

Nomenclature

Common names

Biology

Lake Baikal, in eastern Siberia, is the deepest lake in the world and is reknowned for its endemic fauna. It covers 31,500 sq.m., is long and narrow, has two basins and a maximum depth of 1741m. Over 300 rivers and streams flow into the lake, and it drains to the Arctic Ocean via the Angara river in the south-west. The lake water is often turbulent with strong currents. There are numerous hot springs in the surrounding area (Boss, 1978; Kozhov, 1963).

The molluscs are probably the most diverse faunal group in the lake after the amphipods. About 56 of the recorded 84 mollusc species in the lake are endemic; as in Lake Ohrid, most of the endemics are prosobranchs. The main species radiations are in the hydrobiids, with the notable endemic family Baicaliidae, and in the planorbids and valvatids. The endemic species are found only in the main body of the lake, rarely shallower than 0.5m depth. Maximum mollusc abundance is between 15 and 20m; below 250m only a very few deepwater forms are found such as Benedicta fragilis, B. maxima and Valvata bathybia. The low water temperature and calcium temperature of the lake means that many species have very thin shells. The Baicaliidae include numerous very variable species, richly ornamented with knobs and striations (Boss, 1978; Zhadin, 1965).

Status

The Baikalsk pulp and paper industry complex has a huge effluent discharge and produces signficant air pollution; other pollution sources include a thermal power plant, domestic sewage and a fish cannery (Unesco Advisory Group, 1990?). Logging in the surrounding areas was a potential source of siltation (Pryde, 1972; Galaziy, 1980) but wood cutting in the near shore zone has been prohibited since 1986. There are numerous reports with information on threats to Lake Baikal and these are reviewed in Anon (1990), Massey Stewart (1990a and b) and Galiziy (1980). There is clear evidence that much of the fauna has been affected (e.g. crustaceans and fish), but it is not yet known to what extent the molluscs have been affected.

PLANORBIDAE

Choanomphalus amauronius Bourguignat, 1862	lake, and Angara R. cover distance of 600km (Zhadin, 1965)
C. annuliformis Koshov, 1936	north lake (Zhadin, 1965)
C. anomphalus Dybowski, 1901	lake and sources of Angara R. (Zhadin, 1965)
C. gerstfeldtianus Lindholm, 1909	lake (Zhadin, 1965)
C. maacki Gersfeldt, 1859	lake and Angara R. which drains it (Zhadin, 1965)
C. patulaeformis Lindholm, 1909	lake (Zhadin, 1965)
C. schrencki Dybowski, 1875	lake (Zhadin, 1965)

ANCYLIDAE	
Pseudancylastrum kobelti (Dybowski, 1884)	nr source of Angara, on stones, 1.5-10m (Zhadin, 1965).
P. sibiricum (Gerstfeldt, 1859)	lake and upper reaches of Angara; stony & sometimes sandy bottoms, 2-20m (Zhadin, 1965)
P. troscheli (Dybowski, 1875)	stony and sandy bottoms, 1.5-40m (Zhadin, 1965)
VALVATIDAE	
Valvata baicalensis Gerstfeldt, 1859	lake only; stony, silty or sandy bottoms, 3-20m (Zhadin, 1965)
V. bathybia Dybowski, 1886	lake, 50-200m (Zhadin, 1965).
V. lauta Lindholm, 1909	lake, sand, silty bottoms, 2-50m (Zhadin, 1965)
V. piligera Lindholm, 1909	Maloe More Strait (Zhadin, 1965)
HYDROBIIDAE	
Benedicta baicalensis (Gerstfeldt, 1859)	on sand and stones overgrown with algae, 1-100m deep; lake and Angara R. (Zhadin, 1965).
B. fragilis Dybowski, 1875	sand & silt, over 30-50m deep, Maloe More Strait (Zhadin, 1965).
B. limnaeoides (Schrenck, 1867)	3-60m, sometimes 100m, deep; sand and sandy/silty substrates (Zhadin, 1965).
B. maxima (Dybowski, 1875)	sand & silt, 40-260m deep (Zhadin, 1965).
Bithynia contortrix Lindholm, 1909	bays and near outlet of Barguizan R. (Zhadin, 1965).
Kobeltocochlea martensiana (Dybowski;, 1875)	sandy, stony bottoms; 2-150m (Zhadin, 1965)
K. pumila Lindholm, 1924	50-120m (Zhadin, 1965)
BAICALIIDAE	
Baicalia angarensis (Gerstfeldt, 1859)	stones; Angara R. from lake to Bratskie rapids (Zhadin, 1965)
B. angigyra Lindholm, 1909	north (Zhadin, 1965)
B. bacilliformis Koshov, 1936	sand, silt, 20-70m (Zhadin, 1965)
B. bithyniopsis Lindholm, 1909	sandy/stony bottoms, 3-50m deep, open areas (Zhadin, 1965)
B. cancellata Lindholm, 1909	to 100m (Zhadin, 1965
B. carinata Dybowski, 1875	sand, sand-silt, 2-100m (Zhadin, 1965)
B. carinato-costata Dybowski, 1875	sand, silt, 4-100m (Zhadin, 1965)
B. ciliata Dybowski, 1875	stones overgrown with sponges & algae, 2-15m, lake shore (Zhadin, 1965).
B. columella Lindholm, 1909	stony, sandy bottoms, 3-140m (Zhadin, 1965).
B. contabulata Dybowski, 1875	sand, sand-silt; 1.5-80m (Zhadin, 1965)
B. costata Dybowski, 1875	sand, sand-silt, 2-100m (Zhadin, 1965).
B. duthiersi Dybowski, 1875	sand, silt, 3-100m (Zhadin, 1965)
B. dybowskiana Lindholm, 1909	sand, sand-silt, 3-80m (Zhadin, 1965)
B. elata Dybowski, 1875	sand/silt, 5-50m (Zhadin, 1965)
B. elegantula Lindholm, 1909	stones, 2-10m, Maloe More Strait (Zhadin, 1965)
B. florii Dybowski, 1875	sand, sometimes with detritus; 5-30m, rarely 100m (Zhadin, 1965).
B. godlewskii Dybowskii, 1875	fairly firm sand or silt, 10-250m (Zhadin, 1965)
B. herderiana Lindholm, 1909	stones at lake margins, 1.5-20m, on sand & silt; sometimes deeper (Zhadin, 1965).
B. jentteriana Lindholm, 1909	sand, sand-silt bottoms of bays, 15-100m, north (Zhadin, 1965)

B. korotnewi Lindholm, 1909	silt, 2-200m (Zhadin, 1965)
B. macrostoma Lindholm, 1909	stones, sand 2-40m (Zhadin, 1965)
B. nana Lindholm, 1909	sand, silt, 10-100m; fairly rare (Zhadin, 1965).
B. oviformis Dybowski, 1875	sandy bottom, 4-20m (Zhadin, 1965)
B. pulchella Dybowski, 1875	sand, silt, 4-30m, south (Zhadin, 1965)
B. pulla Dybowski, 1875	sand or silt with detritus, 8-90m, south (Zhadin, 1965)
B. semenkewitschi Lindholm, 1909	sand & silt, 4-70m; all areas (Zhadin, 1965)
B. turriformis Dybowski, 1875	sand, sand-silt, 3-200m (Zhadin, 1965)
B. umbilifera Starostin, 1928	50m deep, nr Ushkani Islands (Zhadin, 1965)
B. variesculpta Lindholm, 1909	stones to 20m depth, sometimes soft bottoms (Zhadin, 1965).
B. werestschagini Koshov, 1936	stones to 3m deep, Maloe More Strait
B. wrzesniowskii Dybowski, 1875	sand, 15-100m, south (Zhadin, 1965
B. zachwatkini Koshov, 1936	sand, silt; 2-100m (Zhadin, 1965)
Liobaicalia stiedae Dybowski, 1875	sand, silt, 15-140, south (Zhadin, 1965)
SPHAERIIDAE	
Pisidium maculatum Dybowski, 1902	silt, sand 2-50m; not in shallow bays or adjacent lakes (Zhadin, 1965)
P. korotnowi Lindholm, 1909	sand, silt-sand, 1.5-60m; not in shallow bays or adjacent lakes (Zhadin, 1965)
Sphaerium baicalense Dybowski, 1902	sand, sand-silt, 1.5-60m; not shallow bays or adjacent lakes (Zhadin, 1965)

Conservation

Numerous research projects are now underway, by both national scientists and international teams (Massey Stewart, 1990), many of them directed towards a better understanding of the lake ecosystem which will provide the basis for sound management. There are two National Parks and three reserves in the immediate vicinity of the lake. Major efforts are underway to stall pollution, and a proposal is being prepared to designate the lake a World Heritage Site (Unesco Advisory Group, 1990?; Massey Stewart, 1990 a and b; Anon, 1990).

Identification Zhadin (1965).

N.B. time constraints meant that this data sheet has not been reviewed by relevant experts; much research and conservation work is underway at Lake Baikal, and there may be significant new information on the molluscs.

LAKE OHRID ENDEMICS **THREATENED**

Class	GASTROPODA		
Order	MESOGASTROPODA	Family VALVATIDAE	4 spp.
		Family HYDROBIIDAE	40 spp.
Order	BASOMMATOPHORA	Family ACROLOXIDAE	2 spp.
		Family PLANORBIDAE	6 spp.
		Family ANCYLIDAE	3 spp.

Nomenclature Valvata relicta (Polinski, 1929) previously Gyraulus relictus; Planorbis macedonicus (Sturany, 1894) previously Gyraulus macedonicus.

Biology

Lake Ohrid, in the karst region of the south-west Balkans, is the only European lake with a Tertiary origin, its waters originating from underground drainage systems. It covers 34,800 ha of which 25,100 ha are in Yugoslavia and 9,700 ha in Albania (Carp, 1980). There is a single basin, rounded in shape and reaching a depth of 286m, and the lake drains to the Mediterranean via the River Drim (Boss, 1978). Few surface rivers flow into the lake and most of its water originates in springs, the majority of which lie near St Naum, and in the Biljana spring region near Bej Bunar. The water temperature is very constant, and never falls below 5°C (Anon, 1979 and n.d.). The shoreline varies from reedbeds and sandy beaches to steep cliffs and the lake bottom shelves steeply. Vegetation includes lake shore pondweeds such as Potamogeton, Myriophyllum and Ceratophyllum, with a number of stonewort Chara species at different depths. The concentric depth zones provide different environments for animal life; the 7-18m zone is dominated by Chara meadows and the 18-35m zone is known as the shell zone on account of the beds of living and dead Dreissena (Hubendick & Radoman, 1959; Carp, 1980). Further information in Stankovic (1960) and Radoman (1985).

The endemic molluscs are found both in the lake and in adjacent springs which feed into the lake. 70-90% of the freshwater snails are endemic; endemism is greatest in the prosobranchs, and the majority of the endemic prosobranchs are found at considerable depth. About 11 of the c. 25 pulmonates are endemic, principally ancylids, acroloxids and planorbids; 42 of the 46 prosobranchs are endemic, mainly hydrobiids (recent taxonomic work has meant that it is difficult to give precise figures on endemism (Boss (1978) gives a figure of 76% endemism based in early data)).

Status

Radoman (1983) mentions threats to, and even the disappearance of, some species (e.g. Ohridohauffenia drimica and Pyrgohydrobia jablanicensis) as a result of river dredging and other engineering work. Pollution is also a problem. The following list must be considered preliminary, and needs further review. Although all the endemics may be considered potentially at risk, it is not yet possible to give IUCN categories.

VALVATIDAE

Valvata hirsutecostata Polinski

Valvata relicta (Polinski, 1929)

Valvata rhabdota Stur.

Valvata stenotrema Polinski

HYDROBIIDAE

Chilopyrgula sturanyi Brusina, 1896	all shore to 4om depth; also in some springs (Radoman, 1983).
Dolapia ornata (Radoman 1956)	stones on shore; Veli Dab & Sveti Naum (Radoman, 1983)
Ginaia munda	G.m.munda (Sturany, 1894) littoral zone; G.m.sublittoralis Radoman, 1978 in sublittoral shell zone, 30-40m (Radoman, 1983).

Gocea ohridana Hadzisce, 1956	east shore, from Veli Dab (Radoman, 1983)
Lyhnidia gjorgjevici Hadzisce, 1956	small lake nr Sveti Naum, by s. bank; not in L. Ohrid (Radoman, 1983)
L. hadzii Hadzisce, 1956	stony shore of e. bank, nr Veli Dab (Radoman, 1983).
L. karamani Hadzisce, 1956	stony shore of e. bank, nr Veli Dab (Radoman, 1983)
L. stankovici Hadzisce, 1956	stony shore of e. bank, nr Veli Dab (Radoman, 1983)
L. sublittoralis Radoman 1967	sublittoral zone below 30 m, near Gorica
Macedopyrgula pavlovici (Polinski, 1929)	sandy littoral zone to 30 m and Chara zone (Radoman, 1983)
M. wagneri (Polinski, 1929)	sublittoral to 40-50m and below (Radoman, 1983)
Micropyrgula stankovici Polinski, 1929	sublittoral shell zone, 30-40m to over 100m (Radoman, 1983)
Neofossarulus stankovici Polinski, 1929	sublittoral to 30-40m depth (Radoman, 1983)
Ohridohauffenia depressa (Radoman, 1965)	stones by shore, Veli Dab (Radoman, 1983)
O. drimica (Radoman, 1964)	stones in river Crni Drim; not found following dredging of the Drim bed below Struga (Radoman, 1983)
O. minuta (Radoman, 1955)	spring at Studenicista, nr Ohrid (Radoman, 1983)
O. rotunda (Radoman, 1964)	stones by shore at Sveti Naum, along e. bank, nr Ohrid (Radoman, 1983)
O. sanctinaumi (Radoman 1964)	small springs nr Sveti Naum; not in lake (Radoman, 1983)
O. sublittoralis (Radoman 1962)	sublittoral to 25-40m, opposite Gorica, near, Ohrid (Radoman, 1983)
Ohridohoratia pyrmaea Westerlund, 1902	Chara zone, to 20m depth; two springs on S. shore (also in Albanian part of lake) (Radoman, 1983).
O. carinata (Radoman, 1956)	stones by shore at Veli Dab on e. bank, and sandy beach on s. bank near Sveti Naum (Radoman, 1983).
Ohridopyrgula macedonica	O.m.macedonica (Brusina, 1896) in shore zone on stones in lake, small lake by Sveti Naum and Zagorican spring; O.m.charensis Radoman, 1978 in Chara zone, 5-20m in lake (Radoman, 1983).
Ohrigocea karevi Hadzisce, 1956	shallow shore zone along east bank (Radoman, 1983)
O. miladinovorum Hadzisce, 1956	shallow zone along east bank (Radoman, 1983)
O. samuili Hadzisce, 1956	stones by shore at Veli Dab; along rocky east bank (Radoman, 1983)
O. stankovici Hadzisce, 1956	shallow zone along east bank (Radoman, 1983)
Polinskiola sturanyi (Westerlund, 1902)	Chara zone, 5-20m deep; usually with Ohridohoratia pyrmaea (Radoman, 1983).
P. polinskii (Radoman, 1960)	stones on shore at Sveti Naum; also springs at Sveti Naum, Zagorican (Albania) and Tusemista (Radoman, 1983).
Pseudohoratia brusinae (Radoman, 1953)	Deep water, over 50 m; near Gorica, Ohrid (Radoman, 1983).
P. lacustris (Radoman, 1964)	Chara zone to 10m depth; north lake (Radoman, 1983)
P. ohridana (Polinski, 1929)	Shore, Chara zone, to 100m; lake (Radoman, 1983)
Pyrgohydrobia grochmalickii (Polinski, 1929)	sand to 5m depth. littoral zone (Radoman, 1983)

P. jablanicensis Radoman, 1955	small artificial lake, 4km w. of Struga; population crashed after building of watergate below spring; 1961 thought extinct but refound since (Radoman, 1983).
P. sanctinaeum Radoman, 1955	small lake by Sveti Naum, s. shore (Radoman, 1983)
Stankovicia baicaliiformis Polinski, 1939	sublittoral and deep zone to 40-60m, especially in shell zone; rare (Radoman, 1983)
Strugia ohridana Radoman, 1973	cave & spring, 4km from Struga (Radoman, 1983)
Trachyohridia filocincta Polinski, 1939	deep zone, 70-80m, sublittoral and shell zones (Radoman, 1983)
Xestopyrgula dybowskii Polinski, 1929	sandy bottom, 5-30m depth (Radoman, 1983)
Zaumia kusceri (Hadzisce, 1956)	subterranean but found in springs, Sveti Naum, s. bank (Radoman, 1983)
Z. sanctizaumi (Radoman, 1964)	2 m depth; s.e. bank, Sveti Zaum (??) (Radoman, 1983)
ACROLOXIDAE	
Acroloxus improvisus Polinski, 1929	Found in the shell zone at 18-35m, in the lake (Hubendick, 1960)
Acroloxus macedonius Hadzisce, 1959	Under limestone rocks at 30-50m, in the lake (Hubendick, 1960)
PLANORBIDAE	
Gyraulus albidus Radoman, 1953	Lake and streams; found on soft-mud bottom but also on gravel; sometimes with G. lychnidicus and on stones on shore; also near shore (?) of R. Drim which forms outlet of L. Ohrid (Hubendick & Radoman, 1959).
Gyraulus crenophilus Hubendick & Radoman, 1959	Springs east of town of Ohrid; found in small creeks formed by spring water on stones and rocks; stenothermic 12-13°C (Hubendick and Radoman, 1959).
Gyraulus fontinalis Hubendick & Radoman, 1959	Occurs in a small pond-like lake s. of L. Ohrid at Sveti Naum (10m in diam; 1-2m above L. Ohrid); receives spring water at 10-11°C; with Potamogeton and other plants (Hubendick and Radoman, 1959).
Gyraulus lychnidicus Hesse, 1928	In littoral zone of L. Ohrid; in stones and gravel (Hubendick and Radoman, 1959).
Gyraulus trapezoides Polinski, 1929	Restricted to depth zone 5-30m, occasionally 0-5m, prefers mud bottom but also in Chara meadows and shell zone (Hubendick and Radoman, 1959).
Planorbis macedonicus (Sturany, 1894)	
ANCYLIDAE	
Ancylus lapicidus Hubendick, 1960	Under limstone rocks at 30-50m, in the lake (Hubendick, 1960)
Ancylus scalariformis Stankovic & Radoman, 1953	In the shell zone at 18-35m, in the lake (Hubendick, 1960)
Ancylus tapirulus Polinski, 1922	In the shell zone, 18-35m; in the lake (Hubendick, 1960)

Conservation

Lake Ohrid was classified as a 'Natural Monument' in 1963 which gives it general landscape protection (Carp, 1980) and a conservation programme was

drawn up. This includes provisions to control development on the shores of the lake, prevent pollution and erosion and to minimize disturbance of the unique wildlife (Anon, n.d.). It is not known to what extent this plan has been implemented and whether the endemic molluscs are being appropriately managed. The lake has been nominated as a World Heritage Site. The Galicia National Park borders the eastern side, from the town of Ohrid to the Albanian border (Anon., n.d.).

Identification: Radoman (1983).

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Identification: Radoman (1983).

'NEAR' ENDEMICS AND SPECIES ENDEMIC TO A GEOGRAPHICAL REGION

These species occur in more than one country, but are restricted to comparatively small geographical ranges and may therefore be at risk. Many, such as the mountain hydrobiids, have the same characteristics as the endemic species described in the previous section; the fact that they are not national endemics is simply a result of the location of country boundaries. Others have rather wider ranges and for example, are restricted to certain mountain ranges, rivers or climatic regions. Sixteen species are described in this section, either briefly below or in the accompanying data sheets, but these are only representative. Further documentation would provide information on many other similar species at risk.

Family Neritidae

Theodoxus transversalis (Pfeiffer, 1828)
(see data sheet for Danube endemics)

Family Viviparidae

Viviparous acerosus (Bourguignat, 1862)
(see data sheet for Danube endemics)

Family Hydrobiidae

Avenionia brevis (Draparnaud, 1805)
K; Very scattered distribution with subspecies in Netherlands (E), Belgium, France, Germany

Bythinella pupoides (Paladilhe, 1869)
I; narrow distribution in south of French-Swiss Jura; in France known only from 5 springs on R.Ain; in Switzerland from only cantons of Vau and Geneva and considered of special concern (Bernasconi, in press; Turner, 1990).

Bythinella reyniesii (Dupuy, 1851)
(see data sheet for Pyrenees Occidentales)

Hauffonia minuta
K; Jura; Switzerland (4/-).

Moitessieria simoniana
(see data sheet for Pyrenees Occidentales)

Sadleriana pannonica (Frauenfeld, 1865)
Carpathian endemic. (E) in Hungary where it occurs on Mt Bukk and other mountainous areas; at 350-650m alt., in clear unpolluted water with alga and liverwort and a calcareous substrate (Szabo, 1985, 1989). Has undergone a 30% reduction in range due to habitat destruction (Szabo, 1990). (V) in Czechoslovakia; distribution in Lisicky (1991). Listed in Hungarian Red Data Book and protected under Hungarian legislation; protected in Hungary within Bukk National Park but thought to be at risk from water pollution and possibly tourism in the national park. It has been translocated to five undisturbed sites (Szabo, 1990).

Family Aciculidae

Renea bourguignatiana Nevill, 1880
(see data sheet for Alpes-Maritimes)

Family Clausiliidae

Charpentieria thomasiana (Kusler, 1847)
Considered rare in Italy; restricted to Piedmont (Bordon in litt., 6.11.90). C. t. studeri (Pini) is endemic to Switzerland; found only on steep, north-exposed slopes below upper timberline between Alpe di Naccio and Pizzo Leone, canton of Ticino (1460-1580m); dependent on beech Fagus sylvatica forest; listed in Swiss Red Data Book (Turner and Ruetschi, 1989; Turner, 1990).

Lamnifera pauli (Mabille, 1865)
(see data sheet for Pyrenees-Occidentales)

Family Zonitidae

Vitrea pseudotrolli Pinter, 1983
(see data sheet for Alpes-Maritimes)

Family Chondrinidae

Solatopupa psarolena (Bourguignat, 1859)
(see data sheet for Alpes-Maritimes)

Family Arionidae

Geomalacus maculosus Allman, 1843
(see data sheet)

Family Helicidae

Monacha granulata (Alder, 1830) (Syn. Ashfordia granulata)
Western Oceanic species, Great Britain, Ireland, Spain, France; damp places and marshy ground in S.E. England and hedgerows in south-west (Bratton, 1991; Kerney and Cameron, 1979). (R) in France; (S) in Great Britain; (R) in Ireland; no information for Spain.

Trissexodon constrictus (Boubee, 1836)
(see data sheet for Pyrenees-Occcidentales)

Elona pyrenaica (Draparnaud, 1805)
Known only from a small number of sites in the Pyrenees-Orientals, particularly in the Massif du Canigou, and on the Catalan side of the Pyrenees; considered a relict distribution (Bouchet, 1990). (R) in France; no information for Spain.

Elona quimperiana (Ferussac, 1821)
(see data sheet)

ALPES-MARITIMES THREATENED ENDEMICS THREATENED

Class	GASTROPODA	
Order	STYLOMMATOPHORA	
Family	ACICULIDAE	Platyla foliniana (Nevill, 1879)
		Renea bourguignatiana Nevill, 1880
		R. gormonti Boeters, Gittenberger & Subai, 1989
		R. paillona Boeters, Gittenberger & Subai, 1989
Family	ZONITIDAE	Vitrea pseudotrolli Pinter, 1983
Family	CHONDRINIDAE	Solatopupa psarolena (Bourguignat, 1859)
Family	CLAUSILIIDAE	Macrogastra lineolata euzieriana (Bourguignat, 1869)

Nomenclature

Common names

Biology Largely restricted to warm dry typically Mediterranean habitats.

Range Endemic to the Alpes-Maritimes, in particular the valleys of the small coastal rivers (Loup, Var, Paillon, Roya) and their tributaries, in France and Italy (Bouchet, 1990); several are endemic to France alone.

Status

The Alpes-Maritimes area is noticeable for the concentration of endemic species in the family Aciculidae (Boeters et al., 1989). The following species are considered to be at risk from habitat destruction on account of their small ranges (Bouchet, 1990; Bouchet in litt., 1990; Ripken, in litt., 1990).

ACICULIDAE	
Platyla foliniana	R; restricted to Alpes-Maritimes in the Gorges de St Louis, near Menton, France (Bodon and Boato, 1987; Bouchet, 1990)
Renea bourguignatiana	Ex?; Gorges de St Louis, Menton, France (Bodon and Boato, 1987; Bouchet, 1990); Vallone de Passo, Liguria, Italy
R. gormonti	R; known only from Gorbio and Monti, near Menton, France; only 25 shells have been found despite intensive searching (Boeters et al., 1989; Bouchet, 1990).
R. paillona	R; known only from the type locality, the Gorge of the Paillon, near l'Escarene, France (Boeters et al., 1989; Bouchet, 1990).
ZONITIDAE	
Vitrea pseudotrolli	R; has been found once at Gorbio, near Menton, France (Gittenberger, 1978) and was subsequently described from these shells and specimens from a second population in Piedmont, Liguria, Italy (Pinter, 1983)
CHONDRINIDAE	
Solatopupa psarolena	E; known only from the Gorges de Saorge, France, at about 500m (last seen 1958) and from adjacent sites in Italy between 700 and 1450m (Boato, 1988). Even at the beginning of this century, this species was thought to be at risk from the construction of the Roya railway (Caziot, 1908).

CLAUSILIIDAE

Macrogastra lineolata euzieriana	R; endemic to upper valley of the Roya; 3 known populations in France only: Saorge, Ste Claire, Gorges de Bergue (Gittenberger and Ripken, 1981; Bouchet, 1990); not under serious threat at present (other subspecies in Italy).

The following species are also endemic to this region but are not at present considered threatened:

Renea moutonii (Dupuy, 1849): recently rediscovered at the type locality, under bushes near Grasse; the five known sites are in the gorges of the Loup and the Siagne in France (Boeters et al., 1989).

R. singularis (Pollonera, 1905): endemic to the valley of the Loup, France, where it occurs in leaf litter in woods; two subspecies: singularis and ripkeni (Gittenberger and Ripken, 1975; Boeters et al., 1989; Bouchet, 1990).

Solatopupa cianensis (Caziot, 1910): endemic to the gorges of the Cians and Daluis, France, between 800 and 1200m; found on red Permian sandstone rocks and scree (Boato, 1988; Bouchet, 1990; Kerney et al., 198).

Chondrina megacheilos caziotana Pilsbry, 1918: endemic to the small area of St Martin de Vesubie, St Etienne de Tinee and the gorges of the Cians, France, between 1000 and 1500m. Other subspecies in Italy (Bouchet, 1990).

Macularia saintyvesi (Caziot in Kobelt, 1906): endemic to gorges of the Cians and the Daluis, France, 900-1200m; found on red Permian sandstone rocks and scree (Bouchet, 1990; Kerney et al., 198).

Conservation

These species are recommended for total protection in France. Parts of the valleys and gorges of the Loup, Var, Cians, Paillon, St Louis, and Roya are recommended for classification as Zones Naturelles d'Interet Ecologique, Faunistique and Floristique (Bouchet, 1990).

Identification

DANUBE ENDEMICS **VULNERABLE**

Class	**GASTROPODA**	
Order	**ARCHAEOGASTROPODA**	
Family	**NERITIDAE**	Theodoxus transversalis (Pfeiffer, 1828)
Order	**MESOGASTROPODA**	
Family	**VIVIPARIDAE**	Viviparus acerosus (Bourguignat, 1862)
Family	**THIARIDAE**	Fagotia esperi Ferussac, 1823

Nomenclature

Common names T. transversalis = Gebanderte Kahnschnecke (Ger.); V. acerosus = Donau Flussdeckelschnecke (Ger.).

Biology
T. tranversalis found in gently flowing rivers on hard substrates; V. acerosus in stagnant or sluggish, muddy water in low-lying country (Pfleger and Chatfield, 1988; Frank et al., 1990). No information for F. esperi.

Range
The Danube is Europe's second largest river, with a length of 2850 km from the Black Forest in Germany to the Black Sea in Romania and the USSR, and over 300 tributaries (Benedeck and Laszlo, 1980). T. transversalis is endemic to the Middle Danube and some of its tributaries, principally the Dniester (?). V. acerosus is endemic to the Danube Basin from Vienna to its mouth (Pfleger and Chatfield, 1988; Frank et al., 1990). F. esperi is endemic to the Danube; range given in Frank et al. (1990).

Status
Pollution, which is steadily worsening, intensive agriculture causing run-off, and alteration of current flow and habitat are the principle threats to species inhabiting the Danube system. A 1988 hydrological expedition found large amounts of a wide variety of pollutants present (Rich, 1991). Some 70 million people live in the Danube Basin and there are 49 planned or existing hydropower stations which will have a major impact on water courses (Benedeck and Laszlo, 1980; Linneroth, 1990). Information has been gathered on three of the endemic species but there may be others; furthermore, many non-endemic but also threatened species also have populations in the Danube that are now at risk. Frank et al. (1990) provide a full review of the distribution and ecology of the Danube malacofauna. This is extremely diverse; for example in Czechoslovakia, 114 species are recorded from the Danube system, seven of which are restricted to this system (Lisicky, in press).

Austria	T. transversalis Ex; previously in Danube and lower parts of tributaries in Nieder-osterreich and Vienna; decline due to agriculture, hydro-engineering and agricultural pollution. V. acerosus E: in Danube backwaters in Nieder-osterreich and Vienna; threatened by agriculture, drainage, industrial and domestic pollution; litter. F. esperi Ex: previously in Burgenland (Frank and Reischutz, in press).
Bulgaria	T. transversalis V; V. acerosus V.
Czechoslovakia	T. transversalis Ex/E: middle Danube lowland, threatened by power stations, on northern edge of range. V. acerosus R; Tisza, northern edge of range. F. esperi E/Ex: middle Danube lowland (Steffek, 1991).
Germany	T. transversalis E/-; previously in Danube down to Ingolstadt, now only in R. Alz; locally abundant and breeding but fluctuating populations and may be affected by

	eutrophication (Falkner & Muller, 1983; Peter, 1989; Falkner, 1991); V. acerosus E/-; occurs in Bavaria; isolated populations at Pfaffer and Passau (Schutte & Weinzierl, 1989; Falkner, 1991).
Hungary	T. transversalis E; Danube, Tisza, Kiskunsag National Park. V. acerosus nt; F. esperi V;dams proposed for the section of the Danube at Bos-Nagymaros will have a major environmental impact (Perczel and Libik, 1989) but it is not known to what extent this will affect molluscs.
Romania	?; both species present but status not known; distribution given in Grossu (1986).
USSR	T. transversalis V; occurs in Danube and Dniester (Zhadin, 1965)
Yugoslavia	?

Conservation

Austria: all three species listed in Red Data Book (Frank and Reischutz, in press); Germany: both species listed in Red Data Book for west (Ant & Jungbluth, 1984) and all three in threatened species list for Bavaria (Falkner, 1991). Hungary: T. transversalis occurs in Kiskunsag National Park; with F. esperi, proposed for national Red Data Book listing (Richnovsky in litt., 1990).

Major efforts are underway to improve environmental conditions in the Danube. The eight countries bordering it have declared their willingness to cooperate on management, especially of pollution, and have drawn up the 'Danube Declaration' (Linnerooth, 1990). Under the new convention, all countries will adopt the same monitoring systems and methods of assessing environmental impact (Rich, 1991).

Identification Pfleger and Chatfield (1988); Zhadin (1952); Fechter and Falkner (1990).

Bibliography

PYRENEES-OCCIDENTALES ENDEMICS THREATENED

Class	GASTROPODA	
Order	MESOGASTROPODA	
Family	HYDROBIIDAE	Belgrandiella pyrenaica Boeters, 1983
		Bythinella reyniesii(Dupuy, 1851)
		Litthabitella elliptica (Paladilhe, 1874)
		Moitessieria simoniana lescherae Boeters, 1981
Order	STYLOMMATOPHORA	
Family	COCHLICOPIDAE	Cryptazeca monodonta de Folin & Berillon, 1877
		C. subcylindrica de Folin & Berillon, 1877
Family	CLAUSILIIDAE	Laminifera pauli (Mabille, 1865)
Family	HELICIDAE	Trissexodon constrictus (Boubee, 1836)

Nomenclature

Common names

Biology The hydrobiids are known from springs or subterranean waters. Cryptazeca monondonta lives under liverworts in permanently damp places and is difficult to find (Bouchet, 1990). Laminifera pauli is known from high altitudes (up to 1000m) but is also found at lower altitudes in calcareous areas; and Trissexodon contrictus is found at low and medium altitudes under large stones.

Status
These species are considered threatened on account of their small ranges and the extreme pressure in this region from development and agriculture. Several are endemic to France. The hydrobiids are at risk from pollution of ground water (Bouchet, 1990).

HYDROBIIDAE	
Belgrandiella pyrenaica	I; known only from the type locality, the grotte de Suhare, at Tardets-Sorhulus, France (Bouchet, 1990).
Bythinella reyniesii	I; found throughout the French Pyreneen region (not unique to western Pyrenees); single population in Andorra (Bouchet, 1990)
Litthabitella elliptica	I; known from about 12 populations in springs near Ascain and St-Jean-Pied-de-Port, France (Bouchet, 1990).
Moitessieria simoniana lescherae	I; subspecies known only from type locality, stream of Alcay, at Tardets-Sorholus, France; the species is found in the pre-Pyrenees coastal areas to the Corbieres (France) and possibly also in Catalan and Aragon (Spain)(Bouchet, 1990).
COCHLICOPIDAE	
Cryptazeca monodonta	E; found at turn of century at St Pierre d'Irube on left bank of Adour near Bayonne, near Cambo-les-Bains, and in the forest at Subercarrere; empty shells found in 1985 at the Grottes de Sare and at Ustaritx, France; more recently found at Zuberoa, Spain, and several other localities in France including Eaux-Bonnes and Soule (Bouchet, 1990).
C. subcylindrica	E; co-exists with C. monodonta i.e. in Spain and France, but has not been found living at the recent sites (Bouchet, 1990).

CLAUSILIIDAE

Laminifera pauli	R; locally common around massif of the Rhune Mountain; more recently found at lower altitude in the south-west and is fairly common at the entrance to the Grotte de Sare, France; several populations known also from the Basque country, Spain (Bouchet, 1990).

HELICIDAE

Trissexodon constrictus	R; localised area in Pyrenees-Atlantiques and Haute-Pyrenees, France, and in the Basque country, Spain (Bouchet, 1990).

Abida secale ateni is another endemic subspecies from the area but is not currently considered in need of protection (Bouchet, 1990).

Conservation
Recommended for total protection in France and their habitats for protection as Zones Naturelles d'Interet Ecologique, Faunistique et Floristique.

Identification

Elona quimperiana (Férrusac, 1821) RARE

Class GASTROPODA
Order STYLOMMATOPHORA Family ELONIDAE

Nomenclature Originally within Helicidae but put in separate family with one other species E. pyrenaica (Gittenberger, 1979).

Common names Escargot de Quimper (Fr)

Biology
Moist deciduous forest and damp heathlands, under stones and bushes. Ecology poorly known but growth studies have been carried out (Daguzan, 1980). Mature at two years; longevity c. 3 years (Daguzan, 1982). Further information in Daguzan and Gloaquen (1986).

Range
France and Spain; a narrow distribution (Kerney & Cameron, 1979; Gittenburger, 1979); occurs very locally in primary woodland, a habitat rapidly disappearing. Mapped in Gittenberger (1979).

Status

France	R; Occurs in Brittany west of a line drawn from Saint-Brieuc to Vannes and locally common in French Pays-Basque at the entrance of the Grotte de Sare (Bouchet, 1990; Cameron, 1981).
Spain	R; localized but locally common; rare in the North-eastern Atlantic coastal areas (Basque region and extreme east of Cantabrian chain) (Prieto et al., 1980); more common in Galicia, Asturias, Santando, Vizcaya y Guipuzcoa (Gittenberger, 1979).

Conservation
France: protected. Listed on Appendix II of the Bern Convention and on the IUCN Red List (IUCN, 1990). Proposed for listing on EEC Habitats Directive and on proposed European Red List of Threatened Plants and Animals (UNECE, 1989).

Identification Gittenberger (1979); Kerney and Cameron (1979).

Geomalacus maculosus Allman, 1843 VULNERABLE

Class GASTROPODA Order STYLOMMATOPHORA
Family ARIONIDAE

Nomenclature synonym: grandis Simroth, 1893, sensu Murillo, 1981

Common names Kerry Slug, Spotted Irish Slug (Eng).

Biology
Occurs in two rather different biotopes, on lichen-covered boulders (where it shelters under patches of deep moss) of non-calcareous rock, close to water in open country and, over most of its altitudinal range, on trunks of lichen and moss-covered trees in old decidous woodland (where it shelters beneath bark of rotten logs etc.). The open country biotope in which this slug occurs is caused by forest clearance. It is active throughout much of the winter, but aestivates for part of the summer. Food: browses lichens and algae (and probably a range of other materials) in the wild and feeds on various vegetables, fungi and breakfast cereals in captivity. Life history reviewed in Platts and Speight (1988).

Range
South-west Ireland, north Portugal, north-west Spain. Recorded in error from Great Britain and France (see Platts and Speight, 1988). Not known outside Europe.

Status

Ireland	R; found in four adjacent 50 km squares within the Devonian old red sandstone areas of W. Cork and Kerry, south-west Ireland, with post-1950 records from more than thirty 10 km squares (Platts and Speight, 1988). Not threatened but generally except in some localities by spread of Rhododendron ponticum, which prevents woodland regeneration and causes disappearance of lichens from boulders, and changes in land use especially for tourism (Ross in litt., 3.12.90).
Spain	I; found in the provinces of La Coruna, Leon, Lugo, Palencia, Pontevedra, northern Spain. Most post-1950 records from Galicia (Murillo, 1981).
Portugal	E; found in Beira Baixa and Minho, northern Portugal. but only one post-1950 record. Seriously threatened by land-use changes and forestry operations, in particular conversion of large areas of sessile oak forest Quercus robur and cork oak Q. suber into Eucalyptus forest (Platts and Speight, 1988).

Conservation
Ireland: protected by Ministerial Order, July 1990; occurs in three protected sites (Glengarriff and Uragh Woods NNR (Kerry, west County Cork) and Killarney National Park).

Listed on Appendix II of the Bern Convention and in the IUCN Red List (IUCN, 1990). The species can be maintained and bred successfully in captivity (Platts and Speight, 1988). Proposed for listing on the EEC Habitats Directive and in the European Red List of Threatened Plants and Animals (UNECE, 1989).

There is need for more precise data on the distribution of this species in Spain and for systematic survey to establish if and where it still survives in Portugal. Most protected sites in which this species occurs should not be interfered with, although some Irish sites may need low-input agriculture to continue. Captive breeding programmes could be established for potential re-introductions to areas from which it has been lost, if

appropriate habitat conditions can be re-established. It is not known if this is possible as the habitat requirements of G. maculosus are still unclear. Further work on this aspect is required.

Identification Identification keys and coloured photos are given in Platts and Speight (1988).

Bibliography Literature reviewed in Platts and Speight (1988).

WIDESPREAD BUT DECLINING SPECIES

Twenty-eight species have been identified under this category as requiring particular attention, and are described in the following data sheets. They include six freshwater gastropods, six freshwater mussels, four freshwater pea mussels, nine gastropods found mainly in wetland habitats and three other terrestrial species.

Factors contributing to the decline of terrestrial and wetland species were discussed in the section on 'Principal Threats'. Wetland species clearly predominate, which reflects the vulnerability of their habitat. There would appear to be less information on molluscs restricted to vulnerable terrestrial habitats such as woodlands, apart from endemic and near endemic species (see earlier). One example is Spermodea lamellata (Jeffreys, 1830) (family Vallonidae) which is found in old native deciduous woods, in leaf litter and under fallen timber. It has a north-west European Atlantic range (Kerney and Cameron, 1979; Bratton, 1991) and flourishes locally in Great Britain which forms a major part of its range but is now thought to be rare or threatened in several countries (e.g. Netherlands (E), Germany (R), Sweden (R), Norway (R)). Further study is required to analyse the data now available for terrestrial species in individual countries and to put this in a regional context.

The two groups of freshwater molluscs involved merit a little further discussion.

Unionids

The unionids or freshwater mussels are perhaps of greatest concern of all species. The plight of the freshwater pearl mussel Margaritifera margaritifera, now seriously threatened in 16 countries is well documented (see data sheet) and major conservation efforts are underway. However, a further five unionids are sufficiently at risk to be included with data sheets, and many others, such as Anodonta cygnaea, Unio pictorum and Unio tumidus, are considered locally declining. These have been best studied in Germany, where work has been underway on several species for about 20 years. There is now a general consensus of opinion that most species have contracting ranges. In Austria, all unionid species are thought to be vulnerable, particularly populations in running waters; Sackl (in litt. 20.9.90) considers this group to be the most endangered freshwater life in Austria due to pollution and river engineering. In Poland many are at risk from pollution and habitat destruction (Dyduch-Falniowska, 1989 and in litt., 6.11.90). Some French populations may be more secure that many others. Many unionid populations are threatened by dams in the same way that damming of the Tennessee River contributed to the extinction of a large proportion of the endemic North American unionids (Wells et al., 1983). Even Anodonta piscinalis, which is found in eutrophic lakes, has been found to disappear from lakes polluted with sewage in Sweden (Okland, in litt, 1990).

Pea mussels

The sphaeriids or pea mussels have been surprisingly well studied, given their tiny size. The distributions of the north European species are well known. Most of these species are widespread and there are no narrow endemics. It is particularly difficult to determine the status of these species, but very few are seriously at risk. Pea mussels are easily dispersed by birds and many species show an ability to recolonise sites where previous populations have disappeared, e.g. from temporary water bodies. They appear to be easily affected by climatic changes and historically their distribution has been far from stable. Many

of the west and central European species extended their range northwards following the retreat of the glaciers. Further more, their small size means that they are often overlooked, and detailed searches may reveal populations to be far more abundant that might appear superficially (Kuiper in litt., 1990).

Although few are threatened enough to warrant IUCN categorisation, pea mussels are vulnerable to acidification and eutrophication. Most work on this has been carried out in Norway, in a study undertaken because of the important role that this group plays in the diet of freshwater fish (Okland and Okland, 1981; Okland and Kuiper, 1982). The calcium-poor mountain lakes here are vulnerable to acidification and the deep water lowland lakes to eutrophication; fish in over two thousand lakes have disappeared because of acidification, and in other lakes fish populations have been seriously reduced. Certain of the sphaeriids e.g. the northern cold water species, seem to be particularly sensitive to such factors (Okland and Kuiper, 1982; Okland, 1991a), although as yet no species are considered at risk of extinction.

Probably only the two river species, Sphaerium solidum and S. rivicola, are at risk throughout Europe, reflecting the widespread pollution of many European rivers. Two Pisidium species (pseudosphaerium and tenuilineatum) may be of concern and have been listed because they are included on many national threatened species lists. Piechocki (1989 and in press) considers a number of the Polish sphaeriids to be at risk, again reflecting mainly the serious nature of pollution.

Valvata macrostoma Morch, 1864 OF SPECIAL CONCERN
Valvata pulchella (Studer, 1820)

Class GASTROPODA Order MESOGASTROPODA
Family VALVATIDAE

Nomenclature: These two species have frequently been considered synonomous but they are now generally considered separate species.

Common names: V. macrostoma = Sumpf-Federkiemenschnecke; V. pulchella = Moor-Federkiemenschnecke (Germ.)

Biology V. macrostoma is restricted to still or slow-moving water in well-vegetated lowland habitats with a high species diversity, including ditches, small ponds and lakes. In Great Britain found mainly in drainage ditches in marshes, often associated with other threatened species such as Anisus vorticulus, Segmentina nitida and Pisidium pseudosphaerium (Bratton, 1991). V. pulchella often found in moorland water, calcareous fens and ditches; considered by Falkner (1991) to be intolerant of drought and usually in acid water, but by Frank et al. (1990) to be drought resistant.

Range: Central and north European, but full range unclear because of confusion between the two species. V. macrostoma generally found in north and west Europe; V. pulchella has a Euro-Siberian range (Frank et al., 1990) and is found in central and east Europe and the Alps.

Status
Both species are declining in a number of countries:

Austria	V. pulchella: V Oberosterreich, Vienna and Niederosterreich; threatened by agriculture, pollution, and drainage (Frank and Reishutz, in press).
Belgium	?
Czechoslovakia	V. pulchella: V; Danube, Tisza, Slovak karst.
Denmark	?
Finland	V. macrostoma nt
France	?
Germany	V. pulchella: E/E; scattered distribution but rare throughout; single record from Saxony; threatened in Hesse (Jungbluth, 1987), Schleswig-Holstein (Anon, 1982), Bavaria (Falkner, 1991) and Nordrhein-Westfalen (Ant and Jungbluth, 1987). In Bavaria, scattered distribution in Alps and foothills, threatened by agriculture (Falkner, 1991). V. macrostoma: scattered but locally abundant in Danube and Wormitz valley; population between Straubing and Vishofen threatened by canalisation (Falkner, 1991; Fechter and Falkner, 1990); declining due to intensive agriculture and canalisation.
Great Britain	V. macrostoma: V; scattered populations in south ; still abundant at some localities but generally declining (Bratton, 1991)
Hungary	V. pulchella: ?; only two localities.
Ireland	?
Netherlands	V. pulchella: E; very rare in river district.
Norway	does not occur (but V. macrostoma recorded from the Swedish part only of a shared lake).
Poland	V. pulchella: V; disappearing as a result of habitat loss, industrial pollution and eutrophication (Falniowski in litt., 2.11.90).

Sweden	V. macrostoma: R; on edge of range; few scattered localities in south and central parts of country and in Oland; threatened by drainage (Andersson et al., 1987).
Switzerland	E (1/-) (as pulchella); Bern, Geneva, Neuchatel, Thurgovia, S (Turner, 1990).
USSR	?

Conservation
Austria: V. pulchella listed in Red Data Book (Frank and Reischutz, in press). Germany: V. pulchella listed in Red Data Book for west (Ant & Jungbluth, 1984) and in lists for Hesse (Jungbluth, 1987), Schleswig-Holstein (Anon, 1982), Baden-Wurttemburgs (Jungbluth & Burk, 1985), Bavaria (Falkner, 1991) and Nordrhein-Westfalen (Ant and Jungbluth, 1987); occurs in a reserve in Saxony and in reserve at Schwillach Moors in Bavaria which is threatened by intensive agriculture in surrounding area (Falkner, 1991). V. macrostoma in list for Bavaria (Falkner, 1991). Great Britain: V. macrostoma occurs in one national nature reserve and 5 SSSIs (Sites of Special Scientific Interest); listed in Red Data Book (Bratton, 1991). Sweden: V. macrostoma listed on national list of threatened species (Andersson et al., 1987); data sheet compiled for National Swedish Environment Protection Board (von Proschwitz in litt., 29.11.90). Switzerland: V. pulchella listed in Red Data Book (Turner, 1990).

Identification Ellis (1969); Adam (1960), Fechter and Falkner (1990). Easily confused with Valvata piscinalis.

Anisus vorticulus (Troschel, 1834) OF SPECIAL CONCERN

Class GASTROPODA Order BASOMMATOPHORA
Family PLANORBIDAE

Nomenclature: Formerly known as Planorbis vorticulus Troschel.

Common names Little Whirlpool Ram's Horn Snail (Eng.); Zierliche Tellerschnecke (Germ.)

Biology
Calciphile, living in permanent water of marsh drains in clean still water with rich aquatic flora; often floats on surface. In Great Britain, often found with other rare species such as Valvata macrostoma and Segmentina nitida (Bratton, 1991; Frank et al., 1990).

Range
Mainly central and southern European east to Western Siberia (Bratton, 1991; Zhadin, 1965).

Status
Scattered and rare throughout much of its range.

Austria	E; Vorarlberg, Tirol, Burgenland, Nieder-Osterreich, Vienna (Ex); threatened by hydraulic engineering, agriculture, pollution (agriculture, domestic, industrial), drainage, litter (Frank and Reischutz, in press).
Belgium	R?; recently found as result of rechecking museum specimens; recorded from Bolderberg (Zolder) (Sablon & van Goethem, 1989).
Bulgaria	?
Czechoslovakia	R; Danube Plain, E. Slovakia, Labe (Steffek, 1987, 1989); distribution in Slovakia mapped in Lisicky (1991).
Denmark	?; no recent information?
France	I; backwaters in alluvial plain of R. Doubs (Jura), Rhone and Rhine; threatened by habitat destruction.
Germany	?/R; rare in east, exact status in west not clear but thought to be threatened; threatened in Hesse (Jungbluth, 1987), Baden-Wurttembergs (Jungbluth & Burk, 1985), Schleswig-Holstein (Anon., 1982) and Bavaria, where its status is critical as a result of habitat loss (Falkner, 1991).
Great Britain	V; reported from about 15 sites; main surviving populations in compact area in marshlands east of Norwich; scattered colonies also in W. Norfolk, Middlesex, W and E. Sussex (Kerney, 1976). Surviving populations potentially or actually threatened by drainage, overfrequent dredging and eutrophication (Bratton, 1991).
Hungary	nt, but not frequent (Richnovsky in litt., 1990)
Italy	?; no information
Netherlands	R?; stagnant freshwater rich in vegetation; a few scattered localities
Poland	I (Piechocki in litt., 1984)
Romania	?; distribution in Grossu (1987)
Sweden	E; single locality in Scania at Ringsjon (Nilsson, 1957): large lake with reeds; threatened by hydro-engineering and eutrophication (Andersson et al., 1987); on edge of range.

Switzerland	R (3/-); clear standing water; Geneva, Grisons, Saint Gall, Zurich (Turner, 1990).
USSR	nt? (reported to be widespread but rare (Zhadin, 1965))
Yugoslavia	?; present but status not known (Frank et al., 1990).

Conservation
Austria: listed in Red Data Book (Frank and Reischutz, in press); Germany: listed in Red Data Books and lists for Hesse (Jungbluth, 1987), Schleswig-Holstein (Anon, 1982), Baden-Wurttembergs (Jungbluth & Burk, 1985) and Bavaria (Falkner, 1991); Great Britain: listed in Red Data Book; occurs in several reserves and SSSIs (Sites of Special Scientific Interest) (Bratton, 1991); Sweden: listed on national list of threatened species (Andersson et al., 1987) and data sheet compiled for National Swedish Environment Protection Board (von Proschwitz in litt., 29.11.90); Switzerland: listed in Red Data Book (Turner, 1990).

Identification Described in Ellis (1969), Macan (1949) and Adam (1960).

Gyraulus laevis (Alder, 1838) **OF SPECIAL CONCERN**

Class **GASTROPODA** Order **BASOMMATOPHORA**
Family **PLANORBIDAE**

Nomenclature: formerly known as Planorbis laevis Alder; Planorbis glaber Jeffreys; Anisus laevis (Alder)

Common names Smooth Ram's Horn (Eng.); Glattes Posthornchen (Germ.).

Biology: On water-weeds in lakes and ponds in clean water; still or slow-flowing water. In Germany in shallow plant-rich ponds and lakes (Gloer et al., 1985); in Ireland and Netherlands in dune slacks. Has a relict distribution, often in sites with a saline influence up to 3-5 ppt; ecology in Norway described in Okland (1990).

Range Holarctic: throughout Europe to Middle and N. Asia; possibly also N. Africa and N. America (Zhadin, 1965; Meier-Brook, 1983).

Status
Status outside Europe not known. In Europe, widespread but often local.

Austria	V; Tirol, lower Austria and Karnten only; threatened by hydraulic engineering, agriculture, pollution (domestic, industrial, agricultural), draining, rubbish (Frank and Reischutz, in press).
Balearics	?; occurs (Paul, 1982) but no detailed information.
Belgium	?; clean pure water; rare; a few places in central and southern regions (Adam, 1960).
Bulgaria	?
Czechoslovakia	R; occurs in Bohemia, Moravia and Slovakia; many recent localities in Bohemia now destroyed, but more common in Slovakia (Steffek, 1987 and 1989); mapped by Steffek (1983) and Lisicky (1991).
Denmark	R; some information in Mandahl-Barth (1949).
Finland	nt
France	K; ?Fier, Pyrenees orientales
Germany	E/?; endangered in west, despite its wide distribution. threatened in Hesse, Baden-Wurttembergs, Bavaria (found only in isolated localities (Falkner, 1991)) and Nordrhein-Westfalen; Brandenburg, Oberschlesian and Thuringia (Brohmer et al., 1956).
Great Britain	nt
Hungary	V; widespread,
Iceland	R; occurs in small ponds in a few localities (Einarrson in litt., 1990)
Ireland	R; scattered localities in W. Mayo, N. & W. Donegal; may be underrecorded.
Italy	?; full distribution not known but occurs at least in Lago di Comalbio and Lago di Granua (Varese), Lago di Montorfano (Como) (Annoni et al., 1978).
Liechtenstein	?; occurs at three localities (Trub, 1988).
Netherlands	V/R; stagnant freshwater, does not tolerate pollution; prefers clear water behind dunes.
Norway	R; three ponds on small island (Gasoy) in north (Okland, 1990)
Poland	R (Piechocki in litt., 1984)
Romania	?; distribution in Grossu (1987).

Sweden	E (Andersson et al., 1987); calcareous fens and small lakes and ponds; a few records only this century including a record in Lapland in 1989; threatened by drainage (Walden pers comm., 1990; von Proschwitz in litt., 29.11.90).
Switzerland	R; 3/2; shallow plant rich water; Geneva, Jura, Neuchatel, Schaffhause, Valais (Turner, 1990).
USSR	nt?; (widespread but comparatively rare in swamps, spring sna river flood plains (Zhadin, 1965)).
Yugoslavia	?; present (Frank et al., 1990) but status not known.

Conservation
Austria: listed in Red Data Book (Frank and Reischutz, in press); Germany: listed in Red Data Books and lists for west Germany (Ant & Jungbluth, 1984), Hesse (Jungbluth, 1987), Bavaria (Falkner, 1991), Baden-Wurttembergs (Jungbluth & Burk, 1985) and Nordrhein-Westfalen (Ant and Jungbluth, 1987). Hungary: occurs in Kiskunsag National Park; Sweden: listed in Red Data Book (Andersson et al., 1987); Lapland site to be protected; data sheet compiled for National Swedish Environment Protection Board (von Proschwitz in litt., 29.11.90); Switzerland: listed in Red Data Book (Turner, 1990).

Identification Ellis (1968); Macan (1949); Okland (1990); Fechter and Falkner (1990).

Segmentina nitida (Muller, 1774) OF SPECIAL CONCERN

Class GASTROPODA Order BASOMMATOPHORA
Family PLANORBIDAE

Nomenclature Formerly known as Anisus nitidus, Planorbis lineatus Walk.

Common names Shining Ram's Horn Snail (Eng); Glanzende Tellschnecke (Germ.).

Biology
Found in ponds and weedy ditches, drainage ditches in marshes, occasionally in lakes. Prefers clean hard water with dense vegetation. In Great Britain, occurs with a rich associated fauna (Bratton, 1991). Generally found in still water or with a feeble current (Adam, 1960). In Germany found in clear, plant-rich ponds, lakes, and pools in meadows (Gloer et al., 1985). Ecology in Norway described in Okland (1990).

Range
Northern and Central Europe (except extreme north-west), north to 62°N in Finland, also northern Asia and parts of Middle Asia.

Status

Austria	E; scattered distribution; threatened by hydraulic engineering, pollution (agriculture, domestic, industrial), habitat destruction, drainage, litter (Frank and Reischutz, in press).
Belgium	?; generally uncommon, very rare in Ardennes (Adam, 1960).
Bulgaria	?
Czechoslovakia	?; distribution in Slovakia mapped in Lisicky (1991).
Denmark	nt; widely distributed (Mandahl-Barth, 1949)
Finland	nt; some records in south (Okland, 1990).
France	V; very rare and poorly known; found rarely in old beds of the Rhone river in the east.
Germany	R/V; Rare in west (distribution not known) and threatened in Hesse, Bavaria, Baden-Wurttembergs, Nordrhein-Westfalen; Vulnerable in east and threatened by swamp drainage.
Great Britain	E. Since 1965 found at only a few sites in Norfolk, Suffolk, E. Kent and E. Sussex (Kerney, 1976); extinct over most of England even where it used to be common, e.g. around London. Formerly widespread in ponds in the 19th century and early 20th century; now confined to well oxygenated marsh drains with lush vegetation. Threatened by dredging of marsh drains, habitat destruction, eutrophication and pollution. Surviving populations in areas of traditional marsh land grazing with low phosphate and nitrate levels e.g. Pevensey Levels (Hingley, 1979; Kerney and Stubbs, 1980; Bratton, 1991).
Hungary	nt.
Italy	I; present in Modena but not found in last 10 years (Palazzo, 1983); further information lacking (Bodon, in litt., 6.11.90)
Liechtenstein	?; five localities (Trub, 1988).
Netherlands	nt.
Norway	R; edge of range. Found only in a single overgrown lake in extreme south-east on one of the Hvaler islands, now established as a reserve (Okland, 1990).
Poland	nt.
Romania	?; distribution in Grossu (1987).

Sweden	R; south, scattered localities; small water bodies and in littoral zone of lakes (von Proschwitz in litt., 29.11.90); clear and aerated calcareous water with high pH; threatened by drainage and eutrophication (Andersson et al., 1987).
Switzerland	V (2/-); rare in west, north and east; plant rich and clear water (Turner, 1990).
USSR	Probably not threatened; found in meadowmoors and drainage canals of swamps. Baltic Basin, Black Sea Basin (inc. Danube and Dneister, Dnieper and others), Caspian Basin, Volga Basin, possibly Amur Basin, Middle Asia and N. Caucasus (Zhadin, 1952).

Conservation
Austria: listed in Red Data Book (Frank and Reischutz, in press). Germany: listed in Red Data Books and Lists for the west (Ant & Jungbluth, 1984), Hesse (Jungbluth, 1878), Bavaria (Falkner, 1991), Baden-Wurttembergs (Jungbluth & Burk, 1985) and Nordrhein-Westfalen (Ant and Jungbluth, 1987). Great Britain: occurs in 5 SSSIs (Sites of Special Scientific Interest) and one National Nature Reserve (Pevensey Levels); listed in Red Data Book (Bratton, 1991). Norway: only known locality is a reserve. Sweden: listed on national list of threatened species (Andersson et al., 1987); data sheet compiled for National Swedish Environment Protection Board (von Proschwitz in litt., 29.11.90). Switzerland: listed in Red Data Book (Turner, 1990).

Proposed for listing on Appendix II of the Bern Convention (Collins and Wells, 1987). Listed on IUCN Red List (IUCN, 1990) and proposed for listing on European Red List of Threatened Animals and Plants (UNECE, 1989).

Identification Descriptions in Macan (1949), Ellis (1969), Adam (1960), Zhadin (1952), Fechter and Falkner (1990) and Okland (1990).

Lymnaea glabra (Muller, 1774) OF SPECIAL CONCERN

Class GASTROPODA Order BASOMMATOPHORA
Family LYMNAEIDAE

Nomenclature often known as Stagnicola glabra on the continent; also as Galba glabra and Omphiscola glabra.

Common names Mud Snail (Eng.); Langliche Sumpfschnecke (Ger.).

Biology
In Great Britain lives in soft water in small muddy pools and ditches, especially in places which dry out occasionally and where aquatic flora is poor; never found in rich aquatic habitats with high molluscan diversity; many sites on ancient uncultivated land on acid sandy or gravelly soils e.g. heaths and commons (Bratton, 1991; Boycott, 1936). In Sweden found in small water bodies. In Germany in temporary plant-rich ditches and pools, absent from larger water bodies, and often in calcareous water with organic iron (Gloer et al., 1985; Fechter and Falkner, 1990). Ecology in Norway described in Okland (1990).

Range
Western Palearctic; reaches 61 deg. N in Scandinavia, and restricted to centeral parts of western Europe; everywhere local (Bratton, 1991); single records from 'East Prussia' and 'Spanish Morocco' (Hubendick, 1951 (with map)).

Status
Scattered and rare throughout its range and declining in many areas.

Belgium	?; uncommon throughout Campine, rare in Haute-Belgique, no longer reported for the shore and polderland (Adam, 1960).
Bulgaria	?
Denmark	E; found only rarely (Mandahl-Barth, 1949)
France	I/K; uncommon in the north and east; common in the west and south-west (Adam, 1960)
Germany	E/R; endangered in west (considered threatened in Hesse and Nordrhein-Westfalen), rare in Saxony; found mainly in the north, Tiefland, absent south of Main; probably extinct in Bavaria, as habitats drying out (Falkner, 1991).
Great Britain	V; formerly fairly widely distributed in acidic lowland areas north to Perth; now rare with largest concentration of records in southern part of Vale of York (Kerney, 1976); has become extinct over large parts of lowland England; drainage of boggy areas and elimination of small ponds and field drains are main threats; also eutrophication through leaching from ploughing and direct chemical treatment (Bratton, 1991).
Ireland	E; only known surviving population (Wexford) recently destroyed by farm drainage (Hurley, 1981); may now be extinct.
Netherlands	nt; (many localities; appears in large numbers under right conditions).
Norway	nt
Sweden	R; south-west, occurring in the narrow coastal zone with a few inland localities, threatened by ditching, drainage and eutrophication (Andersson et al., 1987; von Proschwitz in litt., 29.11.90).
USSR	nt (widespread but rare in swamps and temporary pools (Zhadin, 1965)).

Conservation
Germany: listed in the Red Data Books and lists for the west (Ant & Jungbluth, 1984) and east (von Knorre, 1990), Hesse (Jungbluth, 1987), Bavaria (Falkner, 1991) and Nordrhein-Westfalen (Ant and Jungbluth, 1987); Great Britain: Recent records from eight SSSIs (Sites of Special Scientific Interest); listed in Red Data Book (Bratton, 1991). Sweden: listed on national list of threatened species (Andersson et al., 1987) and data sheet compiled for National Swedish Environment Protection Board (von Proschwitz in litt., 29.11.90).

Identification Ellis (1969); Macan (1949).

Myxas glutinosa (Muller, 1774) **VULNERABLE**

Class **GASTROPODA** Order **BASOMMATOPHORA**
Family **LYMNAEIDAE**

Nomenclature Formerly known as Amphipeplea glutinosa (Muller) or Lymnaea glutinosa (Muller).

Common names Glutinous Snail (Eng); Mantelschnecke (Germ.)

Biology
Found in quiet, very clean, often hard freshwater, in drainage ditches, marshes, canals, slow rivers and lakes. Does not tolerate brackish water. Calciphile and possibly very sensitive to pollution. Avoids turbid or weed-choked places and likes firm substrates (Bratton, 1991; Fechter and Falkner, 1990). In Sweden found in well-aerated water with Elodea canadensis in small lakes and ponds. In Ireland, in ditches adjacent to traditionally grazed land. Often seasonal, disappearing in summer. Ecology in Norway described in Okland (1990).

Range
Northern Europe, between the Alps and the Arctic Circle (Finland to 71°N) but everywhere very local. Map of range in Hubendick (1951).

Status
Isolated, declining populations in most places.

Austria	Ex?; previously in the Tyrol; found now only as subfossil (Frank and Reischutz, in press). Decline due to habitat destruction (also possible identification problems).
Belgium	?; throughout Moyenne and part of Basse-Belgique; very rare in Haute Belgique; no longer in Flanders or Namur (Adam, 1960).
Finland	nt?; but uncommon in most parts including north (Okland, 1990).
France	E; rivers in Aube; declining from pollution and habitat destruction.
Germany	E/Ex?; in west, found in north only and almost extinct (Fechter and Falkner, 1990). Threatened in Schleswig-Holstein (Anon., 1982), Bavaria, where it was last seen in 1947 and may be extinct in the three known localities (Falkner, 1991), Baden-Wurttembergs, and Nordrhein-Westfalen (Ant & Jungbluth, 1987); in east, not seen alive since last century although fresh shell found at Eschefeld recently (Zeissler, in litt. 1990).
Great Britain	E; Last recorded 1957 and most British records date from before 1914. In last century recorded in c. 35 sites in south and east England north to Yorkshire; currently present in Chislet Marshes (Kent), R. Yare (Norfolk), L. Bala (Merioneth) and L. Windermere (Westmorland), and found in Oxfordshire (1980s) and Basingstoke Canal (1960s), but both new sites threatened (Walker et al., 1991). Considered the rarest mollusc in Great Britain (Kerney, 1986; Bratton, 1991).
Ireland	R; local in midlands, very rare in north; possibly decreasing from pollution. Still common in a few places in the Royal Canal (which is rapidly degenerating), Grand Canal and some ditches.

Netherlands	V; characteristic of Stratiotes aloides vegetation which has disappeared from many localities.
Norway	R; three lakes in extreme south-east; northernmost lake highly eutrophic over last 20 years and species may be extinct.
Poland	E/Ex: very few records; known from pond in Niepolomice Forest which has disappeard; recorded from Modla L. in north but current status here not known. Probably always rare and local and possibly now extinct (Falniowski in litt., 2.11.90).
Sweden	R; scattered localities in south and around Baltic coast; threatened by eutrophication, hydro-engineering and overgrowth by reeds (Andersson et al., 1987).
USSR	nt?; (widespread in poorly oxygenated waters and overgrown ponds (Zhadin, 1965).

Conservation

Austria: listed in Red Data Book (Frank and Reischutz, in press). Germany: listed in Red Data Book for west (Ant & Jungbluth, 1984) and lists for Schleswig-Holstein (Anon., 1982), Bavaria (Falkner, 1991), Baden-Wurttembergs (Jungbluth & Burk, 1985) and Nordrhein- Westfalen (Ant & Jungbluth, 1987). Great Britain: Protected under Schedule 5 of the Wildlife and Countryside Act; listed in Red Data Book; occurs in two National Parks (Bala L. and L. Windermere) (Bratton, 1991); a recovery plan that would cost £21,500 has been drawn up for populations in this country and would possibly involve translocation from abroad and research to refind populations (Whitten, 1990). Sweden: listed on national threatened species list (Andersson et al., 1987) and data sheet compiled for National Swedish Environment Protection Board (von Proschwitz in litt., 29.11.90).

Listed in IUCN Invertebrate Red Data Book (IUCN, 1990). Recommended for listing on Appendix II of the Bern Convention (Collins and Wells, 1987) and on proposed European Red List of Threatened Animals and Plants (UNECE, 1989).

Identification: Descriptions in Ellis (1969), Macan (1949), Okland (1990) and Fechter and Falkner (1990).

Cochlicopa nitens (Gallenstein, 1848) **RARE**

Class GASTROPODA Order STYLOMMATOPHORA
Family COCHLICOPIDAE

Nomenclature:

Common names: Gorsse Walzenschnecke, Glanzende Achatschnecke, Glanzende Glattschnecke (Germ.).

Biology Temporarily flooded calcareous fens and marshes; sometimes in very wet calcareous woodland (Kerney and Cameron, 1979; Fechter and Falkner, 1990).

Range Central and Eastern Europe, in scattered isolated localities (Kerney and Cameron, 1979).

Status
Scattered and rare throughout most of its range.

Austria	E; widespread but rare; threatened by pollution (agricultural), hydraulic engineering, agriculture, foresting, drainage, litter (Frank & Reischutz, in press).
Bulgaria	?
Czechoslovakia	V; widespread but sporadic distribution (Steffek in litt., 1990); map for Slovakia in Lisicky (1991).
Denmark	E; Seeland.
Germany	?/R; threatened in Nordrhein-Westfalen, Baden-Wurttembergs, Hesse and Bavaria (recently discovered small populations (Falkner, 1991)); rare in east, with scattered localities.
Hungary	R; Csor, Petnehaza
Netherlands	nt.
Poland	nt?; fragmentary distribution in humid areas and marshes; some localities in Sudetes (Prokryszko in litt.).
Romania	?; distribution in Grossu (1987).
Sweden	V; south-east, on edge of range. Isolated colonies in fens with luxuriant vegetation; threatened by woodland drainage, conifer plantation, water course alteration and ditching (Walden in litt., 28.11.90).
Switzerland	R (3/3); Bern, Fribourg, geneva, Neuchatel, Vaud (Turner, 1990).
USSR	?; listed as subspp. of C. lubrica in Likharev & Rammel'meier (1962).
Yugoslavia	

Conservation Austria: listed in Red Data Book (Frank and Reischutz, in press); Germany: on Red Data lists for Bavaria (Falkner, 1991), Nordrhein-Westfalen (Ant & Jungbluth, 1987), Baden-Wurttembergs (Jungbluth & Burk, 1985) and Hesse (Jungbluth, 1987). Sweden: listed in Red Data Book (Andersson et al., 1987); Switzerland: listed in Red Data Book (Turner, 1990).

Identification: Kerney and Cameron (1979), Fechter and Falkner (1990).

Vallonia declivis Sterki, 1892 **VULNERABLE**

Class GASTROPODA **Order** STYLOMMATOPHORA
Family VALLONIIDAE

Nomenclature Synonym V. adela

Common names Grosse Grasschnecke (Ger.).

Biology
Found in moist open grassland and in flood rubbish of rivers; more often found as dead shells (Kerney and Cameron, 1979).

Range
Central European (Kerney and Cameron, 1979)

Status

Austria	E; occurs in Tirol, Saltzburg, and Oberosterreich; threatened by hydro-engineering, agriculture, drainage, pollution from agriculture (Frank and Reischutz, in press).
Czechoslovakia	E; two localities only in Danube lowland; possibly extinct as a result of dam construction (Steffek in litt., 17.12.90); mapped in Lisicky (1991).
France	R
Germany	E/-; threatened in Hesse, Bavaria (new locality found in 1985 at Grossen Seige, Oberzeitdam but threatened by alterations to Danube (Falkner, 1991), Baden-Wurttembergs, and Nordrhein-Westfalen; occurs in a few places in the river valleys of S. Swabia, elswhere mainly as dead shells in scattered localities in the central and south (Kerney and Cameron, 1979).
Poland	I; records include vicinity of Wroclaw, Ruciane-Nida near Olsztyn, and near Niedzyrzecz Podlaski (Pokryszko in litt., 20.10.90).
Switzerland	R (2/-); wet calcareous meadows; scattered localities in Bern, Jura and Neuchatel (Turner, 1990).

Conservation
Austria: listed in Red Data Book (Frank and Reishutz, in press); Germany: listed in Red Data Book (Ant & Jungbluth, 1984), and in Red Data Lists for Hesse (Jungbluth, 1987), Bavaria (Falkner, 1991), Baden-Wurttembergs (Jungbluth & Burk, 1985) and Nordrhein-Westfalen (Ant & Jungbluth, 1987); Switzerland: listed in Red Data Book (Turner, 1990).

Identification Kerney and Cameron (1979).

Vallonia enniensis (Gredler, 1856) **INSUFFICIENTLY KNOWN**

Class **GASTROPODA** Order **STYLOMMATOPHORA**
Family **VALLONIIDAE**

Nomenclature Synonyms: V. pulchella var. enniensis Gredler; V. costellata Sandberger.

Common names: a grass snail (Eng.); Feingerippte Grasschnecke (Ger.).

Biology
Found in exclusively wet places, mainly in calcareous marshes (Kerney and Cameron, 1989); similar habitat to Cochlicopa nitens (Falkner, 1991).

Range
Central and Southern Europe (Kerney and Cameron, 1979).

Status
Known as a fossil from a wider range; may be a relict species in decline, and vulnerable throughout its range (Walden in litt., 28.11.90).

Austria	V; but fairly widespread; threatened by hydro-engineering, agriculture, pollution from pesticides etc., drainage, and abandoning of meadows (Frank and Reischutz, in press).
Balearic Is	?; Majorca (Gittenberger, 1989).
Belgium	single pre-1950 locality (fossil?) (De Wilde et al., 1986).
Canary Islands	?; La Palma (Gittenberger, 1979).
Czechoslovakia	R; sporadic distribution (Steffek, in litt., 1990); Slovak distribution mapped in Lisicky (1991).
France	E; Reims in north, Grasse, Alpes-Maritimes and Aix-en-Provence in south (Chatfield and Stevanovitch, 1988); very local.
Germany	E/R; south and east; Endangered in west, threatened in Hesse, Bavaria (small scattered populations in Danube valley including locality found in 1988 at Obermoss (Falkner, 1991)), Baden-Wurttembergs, Nordrhein-Westfalen and Schleswig-Holstein; Rare in east.
Greece	?; occurs on Kamena Vocula, Kerkyra (Gittenberger, 1989).
Hungary	nt, but taxonomic confusion with V. pulchella.
Italy	?; restricted to W. Liguria and eastern alpine arc; rare (Boato et al., 1982).
Poland	K/E?; isolated localities.
Romania	?; found in marshes; distribution in Grossu (1987).
Spain	nt?; several localities inc. Valencia, Tarragona, Lerida, Barcelona (Gittenberger, 1989).
Sweden	Ex; calcareous fen; last seen live in 1966 in a calcareous fen in south; main threats were drainage and pond filling (Andersson et al., 1987).
Switzerland	V (2/2); calcareous wet habitats at a few isolated spots in Fribourg, Geneva and Vaud (Turner, 1990).
USSR	?; Khar'kov & Poltava regions, Novorossiisk (Likharev & Rammel'meier, 1962).

Conservation
Austria: listed in Red Data Book (Frank and Reischutz, in press); Germany: candidate species for east Germany Red Data Book, listed in Red Data Book for west (Ant & Jungbluth, 1984), and on lists for Hesse (Jungbluth, 1987), Bavaria (Falkner, 1991), Schleswig-Holstein (Anon., 1982), Baden-Wurttembergs (Jungbluth & Burk, 1985) and Nordrhein-Westfalen (Ant & Jungbluth, 1987). Sweden: listed on national list of threatened species (Andersson et al., 1987); Switzerland: listed in Red Data Book (Turner, 1990).

Identification Kerney and Cameron (1979).

Vertigo angustior Jeffreys, 1830 VULNERABLE

Class GASTROPODA Order STYLOMMATOPHORA
Family VERTIGINIDAE

Nomenclature

Common names Narrow-mouthed Whorl Snail (Eng); Schmale Windelschnecke (Germ.).

Biology

V. angustior prefers open habitat without shading, including wet grassy meadows, dune slacks and moist dunes; marshy ground of high, even humidity, not subject to desiccation or flooding, and with short vegetation (Norris and Colville, 1974; Marriott and Marriott, 1982; Killeen, 1983; Preece and Willing, 1984). In Sweden found in open calcareous fens and also dry habitats on sand dunes with low vegetation cover and boulder slopes with deciduous trees (Walden, 1986).

Range

Northern and Central Europe.

Status in Europe

Austria	S; widespread but threatened by hydro-engineering, agriculture, agricultural pollution, drainage and litter (Frank and Reischutz, in press).
Belgium	E; only 2 records since 1950 (De Wilde et al., 1986); declining strongly.
Czechoslovakia	nt; scattered distribution; mapped for Slovakia by Lisicky (1991).
Denmark	V.
Finland	R; edge of range Found only in the archipelago in the south-west and along the Gulf of Finland, south to 63°N; uneven distribution; threatened by habitat damage (Rassi and Vaisanen, 1987).
France	R?; records include fens in Dordogne (Coles et al., 1983).
Germany	-/V; widespread in west but local; threatened in Bavaria; only rarely found in east and threatened by drainage.
Great Britain	E; survives at only about seven sites in East Anglia, Glamorgan and Cumbria; other sites have been lost. In serious decline. Once abundant in lowland Britain but suppressed by mid-Postglacial forest growth. All populations vulnerable to habitat disturbance and change in hydrological conditions (Bratton, 1991).
Hungary	nt
Ireland	V; West/central; one site lost but others recently found and can be abundant at some sites; possibly overlooked but at risk from habitat loss.
Italy	?; occurs in Modena Province (Palazzi, 1983) and south-east Alps (Boato et al., 1989) but full distibution not obtained.
Liechtenstein	?; known from eight localities (trub, 1988).
Netherlands	V; coastal, east and dunes: Limburg, Gelderland, Overijssel.
Norway	V; edge of range; southern regions.
Poland	V; distribution mapped in Pokryszko (1990); scattered localities.
Romania	?; Transylvania - Sibiu, Sighisoara, Medias, Fagaras; also Comona, mountains of Tisaru, R. Siret (Grossu, 1987).

Sweden	S. Edge of range; southern regions, mainly coastal areas; scattered in calcareous areas in interior (von Proschwitz in litt., 29.11.90). Threatened by ditching and woodland drainage (Andersson et al., 1987).
Switzerland	V (3/2); South, west and north; calcareous moist habitats (Turner, 1990).
USSR	nt?; widespread in forests and meadows (Likharev and Rammel'meier, 1962).

Conservation

Austria: listed in Red Data Book (Frank and Reischutz, in press); Finland: listed in Red Data Book (Rassi and Vaisanen, 1987); Germany: listed in threatened species list for Bavaria (Falkner, 1991); Great Britain: several sites lie within SSSIs (Sites of Special Scientific Interest); listed in Red Data Book (Bratton, 1991); Sweden: listed on national list of threatened species (Andersson et al., 1987); Switzerland: listed in Red Data Book (Turner, 1990).

Recommended for listing on Appendix II of the Bern Convention (Collins and Wells, 1987) and European Red List of Threatened Plants and Animals (UNECE, 1989). Listed in IUCN Red List (IUCN, 1990).

Identification Ellis (1969), Kerney and Cameron (1979).

Vertigo genesii (Gredler, 1853) VULNERABLE

Class GASTROPODA Order STYLOMMATOPHORA
Family VERTIGINIDAE

Nomenclature: Has been considered conspecific with V. geyerii but Kerney and Cameron (1979) list it as a good separate species. Older records are difficult to interpret unless based on museum collections.

Common names Round-mouthed Whorl Snail (Eng); Blanke Windelschnecke (Ger.).

Biology
Wetlands: marshy ground, base rich flush; reaches 2000 m in Alps (Kerney and Cameron, 1989). In Great Britain found among mosses and low growing sedges in alkaline flush fed by springs, at 495 m altitude, with relict Arctic-Alpine plants, similar to its typical habitat of sloping calcareous fens in the Swedish mountains (Bratton, 1991; von Proschwitz in litt., 29.11.90).

Range
Northern and Central Europe; restricted mainly to Alps and mountains of central Scandinavia; very local throughout its range (Kerney and Cameron, 1979). Substantial part of recent range in Scandinavia (Walden in litt., 28.11.90).

Status

Finland	R; calcareous swamps only, south to 66 N, uneven distribution; threatened by peatland drainage (Rassi and Vaisanen, 1987).
Germany	E/-; north-west and Bavaria; threatened in Schleswig-Holstein, Bavaria and Nordrhein-Westfalen (but records for Germany unconfirmed ? (Walden in litt., 29.11.90)). Thought extinct in Bavaria through drainage (Falkner, 1991).
Great Britain	E; single locality only, in Teesdale, Co. Durham. First recorded 1979; very small population. Glacial relict once abundant in lowland England; became extinct through climatic change; no immediate threat to the remaining population but small size makes it vulnerable to any habitat change (Bratton, 1991).
Norway	V; in northern regions, on the edge of its range.
Poland	R?; probably occurs but very rare; doubtful records from Bialowieza Forest (Dyduch, 1980; Pokryszko, 1990).
Romania	?; 1800m, shady humid areas; Masival Bucegi near Brina; distribution in Grossu (1987).
Sweden	R; relict distribution in Vastergotland, Ostergotland and calcareous areas in mountains (von Proschwitz in litt., 29.11.90; Walden in litt., 28.11.90); on the edge of its range; threatened by ditching and woodland drainage (Andersson et al. (1987).
Switzerland	R (3/-); Grisons, mountainous calcareous wetlands (Turner, 1990).
USSR	?; rare in damp meadows, Leningrad region, Moscow, Vologda (Likharev & Rammel'meier, 1962); occurs near Polish border near Bialowicza (Dyduch, 1980).

Conservation
Finland: listed in Red Data Book (Rassi and Vaisanen, 1987); Germany: listed in Red Data Book (Ant & Jungbluth, 1984), and on threatened species lists for Schleswig-Holstein (Anon., 1982), Bavaria (Falkner, 1991), and Nordrhein-Westfalen (Ant & Jungbluth, 1987). Great Britain: listed in Red Data Book; single population is in a National Nature Reserve (Bratton, 1991); Sweden: listed on national threatened species list (Andersson et al., 1987); Switzerland: listed in Red Data Book (Turner, 1990).

Recommended for listing on Appendix II of the Bern Convention (Collins and Wells, 1987) and on European Red List of Threatened Plants and Animals (UNECE, 1989). Listed in IUCN Red List (IUCN, 1990).

Identification Kerney and Cameron, 1989.

Vertigo geyeri Lindholm, 1925 — **VULNERABLE**

Class GASTROPODA — **Order** STYLOMMATOPHORA
Family VERTIGINIDAE

Nomenclature Sometimes formerly erroneously known as V. genesii

Common names A Whorl Snail (Eng); Vierzahnige Windelschnecke (Germ.).

Biology
Found in marshy flushes and fens with constant water table, both in lowland and upland wetlands; calciphile. In Great Britain, found in open calcareous fens in hillside depressions fed by springs; usually in places free of mosses but with prolific growth of Eleocharis quinqueflora, Schoenus nigricans and smaller Carex species (Bratton, 1991; Coles and Colville, 1979). In Ireland and on the Continent also in flat lowland fens (Bratton, 1991). In Sweden found in open calcareous fens with Schoenus ferrugineus (Walden in litt., 28.11.90).

Range
Northern and central Europe; in mountains of Scandinavia, Swiss and Austrian Alps and a few places in Ireland but mainly a lowland species (Kerney and Cameron, 1979; Walden in litt., 28.11.90).

Status
Threatened by drainage and water extraction in many countries.

Austria	V/R but fairly widespread (relict distribution); threatened by hydro-engineering, agriculture, drainage, (Frank and Reischutz, in press).
Czechoslovakia	E; relict distribution, sporadic (Steffek, 1987, 1989); distribution in Slovakia mapped by Lisicky (1991).
Denmark	E.
Finland	R; found in treeless brown moss fens, south to 65 30'N, uneven distribution; threatened by peatland drainage (Rassi and Vaisanen, 1987).
Germany	?/?; threatened in east and in Bavaria; isolated localities in north-east and south-east, and in south-west Bavaria (Kerney and Cameron, 1979; Falkner, 1991).
Great Britain	E; one locality only, in Westmorland. A glacial relict. Once common in lowland England, but extinct through climatic change and drainage. Potential threat from habitat change (Bratton, 1991).
Ireland	E; threatened by drainage; a glacial relict (Norris and Pickrell, 1972).
Norway	E; mainly in centre (Walden in litt., 28.11.90), where it is on the edge of its range.
Poland	R?; doubtful records; recorded in early part of centru from near Bialowieza (now in USSR); if it occurs, it is found in meadows and glades and is rare/threatened (Pokryszko, 1990).
Sweden	R; Scania to Lappland; on the edge of its range in Westergotland; very scattered, only in calcareous areas (von Proschwitz in litt., 29.11.90); threatened by wetland drainage.
Switzerland	R (3/-); Inner Appenzell and Grisons; mountainous calcareous wetlands (Turner, 1990).
USSR	?; Latvia and Lithuania (Likharev & Rammel'meier, 1962).

Conservation
Austria: listed in Red Data Book (Frank and Reischutz, in press); Finland: listed in Red Data Book (Rassi and Vaisanen, 1987); Germany: on threatened species list for Bavaria and occurs in Ampermoos Nature Reserve in this state (Falkner, 1991); on threatened species list for Baden-Wurttembergs (Jungbluth & Burk, 1985); candidate species for east Red Data Book. Great Britain: listed in Red Data Book; populations are within an SSSI (Site of Special Scientific Interest) (Bratton, 1991); Sweden: listed on threatened species list (Andersson et al., 1987); Switzerland: listed in Red Data Book (Turner, 1990).

Recommended for listing on Appendix II of the Bern Convention (Collins and Wells, 1987) and on European Red List of Threatened Plants and Animals (UNECE, 1989). Listed in IUCN Red List (IUCN, 1990).

Identification Kerney and Cameron (1979).

Vertigo moulinsiana (Dupuy, 1849) VULNERABLE

Class GASTROPODA **Order** STYLOMMATOPHORA
Family VERTIGINIDAE

Nomenclature synonym V. desmoulinsi Germain

Common names Desmoulins' Whorl Snail (Eng.); Bauchige Windelschnecke (Germ.)

Biology
In Great Britain it is restricted to old long-established calcareous wetlands, usually bordering rivers or lakes. Normally lives in grasses and sedges (e.g. Glyceria maxima or Carex) close to the ground, but may ascend taller vegetation such as Phragmites (Bratton, 1991; Kerney and Cameron, 1979). In Poland found in marshes, fens, reed beds, lake shores and river banks (Pokryszko, 1990). Feeds on moulds on marsh grasses and reeds; requires high humidity and warmth. In Sweden found in marshy bay of small lake on leaves of Carex in water. Further details given in Butot and Neuteboom (1958).

Range
European, but probably Holarctic (Kerney and Cameron, 1979). Widely distributed north to Denmark and southernmost Sweden and Lithuania but regarded as rare in all countries (Bratton, 1991). Southern limit not known precisely (Pokryszko, 1990). It is a relict of warm interglacial or post glacial periods.

Status
Considered to be declining in Europe by the 1950s. In general, alteration of water levels, mowing of river meadows and cultivation or reclamation of marshes threaten remaining populations (Butot and Neuteboom, 1958; Kerney and Cameron, 1979; Fechter and Falkner, 1990). The decline may be partly due to falling temperatures since the climatic optimum (Bratton, 1991).

Austria	E/Ex?; Steiermark; south of Klagenfurt, (Butot and Neuteboom, 1958); Karnten and Burgenland (Ex) (Frank and Reischutz, in press). In chalky soil in swamps and banks of stagnant waterways. Threatened by hydraulic engineering, agriculture, agricultural pollution, drainage, development and others (Frank and Reischutz, in press)
Belgium	Ex?; only 2 post-1950 records (De Wilde et al., 1986) and not found since 1960 (Van Goethem in litt., 1983). Previously recorded from south-east of Brussels (La Hulpe and Genval) (Adam, 1944).
Bulgaria	?; Philippopel, Maritzadal (Hesse, 1916).
Czechoslovakia	E; Tatra mtns (Steffek, 1987, 1989). Recorded from Jasov, Teplicadal (Lozek, 1956); Bardejov (Rotarides and Weis, 1950). Relict populations remaining need protection (Lozek, 1956). Slovak distribution mapped in Lisicky (1991); further information in Lozek and Steffek (1983).
Denmark	V; found near Aarhuus (Schlesch, 1943) and in Funen; mainly in south-east, northern populations destroyed by ditchingon Jutland but several new localities recently found (Walden in litt., 28.11.90); on the edge of its range.
France	E; previously in Départements of l'Ain, l'Aisne, l'Oise, Bas Rhin, Haute Garonne, Gironde (Germain, 1930); full current distribution not known but found around Reims (Chatfield, pers. comm.) and in National Reserve de Chasse in Loire-et-Cher (Colville, 1985).

Germany: E/E; mainly western and southern border scattered localities in north-east; recorded from East Mecklenburg, near Berlin, Rhine valley, Westfalen, Baden (Haas, 1929). Threatened in Hesse, Bavaria, Schleswig-Holstein, Baden-Wurttembergs and Nordrhein-Westfalen. Disappeared from some localities as a result of drainage, particularly around industrial centres (Butot and Neuteboom, 1958) and eutrophication (Falkner, 1991).

Great Britain R; scattered colonies occur in a band from Dorset to Norfolk, with isolated sites in Northamptonshire, Shropshire and North Devon (where it was last seen 1973). Largest populations now in the Norfolk Broads (Bratton, 1991; Kerney, 1976). In the earlier part of the Postglacial period it was much more widely distributed, reaching as far north as Yorkshire; retreat probably partly due to lower temperatures but habitat loss is undoubtedly the main cause. Declining because of drainage of fens and marshes, and river management schemes; all known sites (about 25) are considered vulnerable and several others are known to have been lost in recent years. The species appears to be more sensitive that some marsh Vertigo (e.g. V. antivertigo) to habitat disturbance and is scarcely known to colonise secondary man-made sites (Bratton, 1991).

Hungary nt?; scattered localities including area around Budapest, north of Lake Balaton; extreme east and two sites on the Kiskun plain (Pinter et al., 1979).

Ireland V; threatened by drainage of lowland fens in central areas but many be able to colonise canals.

Italy R; Sicily, Padua, Mantua (Novara, Alessandria, Aosta, Novara) (Butot and Neuteboom, 1958); provinces of Alessandria, Aosta and Novarra (Bishop, 1980); Modena, but not recorded in last 10 years (Palazzi, 1983).

Netherlands E/R; North-west edge of range, in the Geleen Valley, Schinnen (Butot and Neuteboom, 1958). Populations lost through road and house building (Butot, 1982) but two populations recently rediscovered (Gittenberger, 1983), one of which is threatened by water course alteration and increased access to marshes plus lowering of the water table (Ripken, 1982; Keulen, 1985); this latter population is thought to be under serious threat.

Poland E; virtually extinct. Confirmed records include Bialowieza National Park (Dyduch, 1980), the reserve Dziekanow Lesny (1957) in Kampinos Forest near Warsaw, and most recently Lubuskie Lake District (Lubniewice, nr Gorzow Wielkopolski). A new site turned up in July 1985. Many localities have been destroyed by mowing and drainage (Pokrysko, 1983 and 1990). Distribution mapped in Pokryszko (1990).

Spain ?; Near Barcelona and along the Ebro and small rivers in northeastern Catalonia (Boettger, 1936; Haas, 1929).

Sweden E; One locality only in south; threatened by pond filling, water management and eutrophication (Andersson et al., 1987); edge of range.

Switzerland R; 3/2. In calcareous moist habitats. Cantons of Geneva, Vaud, Valais, Berne, Argovie, Fribourg (Mermod, 1930).

USSR nt?; Recorded Poti (on edge of Black Sea) (Westerlund, 1887) and Helenendorf near Elisabethpol (Boettger, 1889); south-west Lithuania (Schlesch, 1943); also west Georgia and west Azerbaijan (Likharev & Rammel'meier, 1962).

Conservation
Austria: listed in Red Data Book (Frank and Reischutz, in press). Czechoslovakia: Population in River Teplica valley protected by State Nature Reserve (Butot and Neuteboom, 1958). Germany: listed in Red Data Book for west (Ant and Jungbluth, 1984) and on threatened species lists for Hesse (Jungbluth, 1987), Bavaria (Falkner, 1991), Baden-Wurttembergs (Jungbluth & Burk, 1985), Schleswig-Holstein (Anon., 1982) and Nordrhein-Westfalen (Ant & Jungbluth, 1987). A population occurs in the "Enkheimer Reid" nature reserve, south of Frankfurt, (Butot and Neuteboom, 1958). Great Britain: known from eleven SSSIs (Sites of Special Scientific Interest) in England (Bratton, 1991). Netherlands: Recommended for legal protection, 10 August 1984, by Natuurbeschermingsraad. Poland: Occurs in Dziekanow Lesny Reserve and Bialowicza National Park (Pokryzko, 1983). Sweden: on official national list of threatened invertebrates (Andersson et al., 1987). Switzerland: listed in Red Data Book (Turner, 1990).

Listed in IUCN Red List (IUCN, 1990). Protection of remaining sites required in most countries. Proposed for listing on Appendix II of the Bern Convention (Collins and Wells, 1987), and for inclusion on the EEC Habitats Directive and the European Red List of Threatened Plants and Animals (UNECE, 1989).

Identification See Ellis (1969) and Kerney and Cameron (1979).

Balea perversa (Linnaeus, 1758) **INSUFFICIENTLY KNOWN**

Class **GASTROPODA** Order **STYLOMMATOPHORA**
Family **CLAUSILIIDAE**

Nomenclature

Common names Tree Snail (Eng); Zahnlose Schliessmundschnecke (Germ.).

Biology
Dry exposed places among rocks and old stone walls, less commonly in trees, very occasionally in ground litter; prefers warm dry microhabitats among stones and in ruins; less common on trees, rarely in fallen leaves (Pfleger and Chatfield, 1988). In Poland in mountains, hills and on old moss-covered stone walls, rocks and under bark (Pokryszko in litt., 20.10.90) Mainly coastal in Scandinavia. Ovoviviparous, laying c. 15 eggs/young towards the end of summer; mature at one year (Adam, 1960).

Range
Widespread in northern and western Europe, from Italy to the Iberian Peninsula north to Great Britain and Scandinavia,but becoming rarer to the east and scarce in the north German plain; scattered incidences in mountains of central Europe (Pfleger and Chatfield, 1988; Falkner, 1991); also in Carbathians, Serbia and Azores (Fechter and Falklner, 1990).

Status in Europe
Thought to be susceptible to pollution by sulphur dioxide (Holyoak, 1978).

Austria	V; scattered distribution; threats include motorway pollution, renovation of old buildings, urban development (Frank and Reischutz, in press).
Azores	?; (S. Miguel)
Belgium	E; declining strongly (van Goethem et al., 1987); only 8 post-1950 live records, mainly in south and west (De Wilde et al., 1896).
Czechoslovakia	S/nt; distribution data in (Flasar 1976/77); distribution in Slovakia mapped in Lisicky (1991).
Denmark	V; sporadic distribution.
Finland	nt; south coast only; edge of range.
France	nt.
Germany	-/R; widespread in west, rarer in east; scarce on northern plain; threatened in Schleswig-Holstein and Bavaria where it has disappeared from some localities and is threatened by the loss of trees and the rebuilding of old walls (Falkner, 1991).
Great Britain	nt; widespread; in the south prefers hedgerows and other isolated trees rather than extensive forest. May have increased in recent years but will decline when dead elms disappear (Collins and Wells, 1983).
Hungary	nt.
Iceland	R; edge of range; recorded from south-east: Kvisker, Oraefi and south: Thorvaldseyri, Raudaberg, Dynjaudi (Einarsson, 1977; Einarrson et al., 1984).
Ireland	nt.
Italy	R/V; little information (Bodon in litt., 6.11.90) but may be becoming rarer in Liguria as a result of human activities (Boato et al., 1982).
Madeira	R; (Walden in press).
Netherlands	R; found on bark of old trees, on old walls, river banks. Vulnerable to habitat destruction.

Norway	nt.
Poland	E; a few localities in Sudetes; scattered single records in Beskidy Mts and Pomerania (Pokryszko in litt., 20.10.90).
Portugal	?.
Romania	?; presence uncertain (Grossu, 1981).
Spain	?; occurs in north.
Sweden	nt; but declining in non-calcareous areas; on the edge of its range.
Switzerland	R; Scattered localities up to 1500m on mossy rocks (Turner, 1990).
USSR	nt?; (known from Crimea, Poles'e, possibly Baltic region (Likharev & Rammel'meier, 1962).

Conservation
Austria: listed in Red Data Book (Frank and Reischutz, in press); Germany on threatened species list for Schleswig-Holstein (Anon, 1982) and Bavaria (Falkner, 1991). Switzerland: listed in Red Data Book. Recommended for listing on Appendix II of the Bern Convention (Collins and Wells, 1987), but probably not a suitable candidate until further information is available. Listed in IUCN Red List (IUCN, 1990) as Vulnerable; proposed for UNECE Red List of Threatened Plants and Animals, but this may need further review.

Identification Kerney and Cameron, 1979; Pfleger and Chatfield (1988).

Catinella arenaria (Bouchard-Chantereaux, 1837) **VULNERABLE**

Class GASTROPODA **Order** STYLOMMATOPHORA
Family SUCCINEIDAE

Nomenclature Formerly known as Succinea arenaria Bouchard-Chantereaux

Common names Sandbowl Amber Snail (Eng)

Biology
Mainly coastal and montane. Wetlands are the main habitat, particularly calcareous fens, dune slacks (Ireland) and primary dunes; prefers base-rich fens fed by springs or sparsely vegetated hollows in stabilised dunes; requires bare ground (Boycott, 1921; Quick, 1933; Coles and Colville, 1979; Bratton, 1991). Coastal in the Netherlands. In Ireland avoids wetlands with occasional large fluctuations in water level and swamp type communities with permanent high water level (Tattersfield, 1991).

Range
Northern Europe; found at isolated sites from Alps to Arctic Circle, Atlantic coast to Slovakia (Kerney and Cameron, 1979; Fechter and Falkner, 1990). Also recorded in North Africa (Tattersfield, 1991).

Status
Generally very scarce.

Belgium	Ex; not recorded since 1960; earlier distribution given in Anteunis (1955) and De Wilde et al. (1986).
France	R; West coast and Alps.
Czechoslovakia	E; 2 localities at Tisevce, relict (Steffek, 1987, 1989); Slovak distribution mapped in Lisicky (1991).
Germany	V/-; scattered localities on coast.
Great Britain	E; Glacial relict, largely eliminated from this country during early post glacial period by forest growth. Very rare and found only in two sites: north Lancashire and Devon. In 19th cent., found near Swansea but now extinct in this site. Its decline may be partly due to climatic changes; also potentially threatened by habitat disturbance and drainage although populations stable at present. Presumably requires some disturbance and regeneration of its habitats because it prefers pioneer vegetation (Kerney, 1982 and 1976; Bratton, 1991).
Ireland	E; Tipperary; recent records from Birr (Co. Offaly) (possibly threatened), Dooaghtry (Co. Mayo), and Inishmore and Inishman (Aran Is); latter populations likely to be important; a glacial relict threatened by drainage - populations in Irish midlands now almost certainly gone through land improvements (Tattersfield, 1991).
Netherlands	E/R; known from a few sites in coastal parts of N & S. Holland, Zeeland & Freisland; disappeared from Schouen I. (Zeeland), Europoort (Hook of Holland) and sites in S. & N. Holland; on Friesian Wadden Is. now found only at Terschelling. The localities are unstable, consisting of pioneer vegetation. Threatened by dyke building, dune reclamation and drainage (Butot in litt., 4.7.90).
Norway	Ex?; The northern edge of its range. Last seen 1925.
Poland	R; Known from a single site at the village of Sitkowka, near Kielce, Swietokrzyskie Mountains (Piechocki, 1981).

Sweden	R; Present in northern mountains, Oland and Gotland (many sites on islands destroyed by ditching). On the edge of its range.
Switzerland	R (2/2); Present in Grisons and Valais; prefers moist muddy areas (Turner, 1990).

Conservation
Germany: Listed in Red Data Book for west (Ant and Jungbluth, 1984). Great Britain: Protected under Schedule 5 of the Wildlife and Countryside Act; listed in Red Data Book; both sites protected in National Nature Reserve and SSSI (Site of Special Scientific Interest) (Bratton, 1991); recovery plan drawn up by Whitten (1990) suggesting improved site management, research, translocation and monitoring at all sites. Ireland: populations on Aran should be protected (Tattersfield, 1991). Netherlands: recommended for legal protection on 10 August 1984 by Natuurbeschermingsraad. Sweden: listed in Red Data Book (Andersson et al., 1987). Switzerland: listed in Red Data Book (Turner, 1990).

Recommended for listing on Appendix II of the Bern Convention (Collins and Wells, 1987). Although this species can be confused with Succinea oblonga, it clearly requires protection; many of its localities are known and listing on the Bern Convention would encourage protection of these sites. Listed in IUCN Red List (IUCN, 1990), and proposed for European Red List of Threatened Plants and Animals (UNECE, 1989).

Identification May require dissection for certain separation from Succinea oblonga Draparnaud, although this isnot necessary for typical specimens. Descriptions in Quick (1933), Kerney and Cameron (1979), Pfleger and Chatfield (1988).

Helix pomatia Linnaeus, 1758 OF SPECIAL CONCERN

Class GASTROPODA Order STYLOMMATOPHORA
Family HELICIDAE

Nomenclature

Common names Roman snail, Apple snail, Edible snail (Eng).
Escargot de Bourgogne (Fr); Weinbergschnecken (Germ.)

Biology
Usually requires limestone or calcareous soils, generally in open woodland, downland, bushes, hedges and tall herbage, but in many countries calcareous soils do not appear to be essential; often found on cultivated ground. Avoids total shade and very damp woods. Found at altitudes of up to 2000m in Alps, but more often in lowland areas. Occurs on cold, forested acid soils as an introduction. Hibernates in winter and secretes calcareous diaphragm. Feeds on a variety of plants. Maturity reached at 2-5 years; reproductive potential high but success is low due to high mortality among eggs and juveniles. Adults are very long-lived and recruitment of new adults to population is slow (Pollard, 1973, 1975; Pollard and Welch, 1975; Lind, 1968; Wells et al., 1983; Fechter and Falkner, 1990).

Range
Widespread in Central and south-eastern Europe, extending westwards to central France and south-east England and north to the south Baltic coasts. Distribution may be naturally alpine but introduced to lowland areas in many places and to many countries in the north and west of Europe (Kerney and Cameron, 1979; Welch and Pollard, 1975).

Status
Primary cause of depletion in many countries is overexploitation for food, but where collecting is minimal, species is generally not under threat, although there are some reports of decline from habitat destruction (e.g. Fechter and Falkner, 1990).

Austria	R; widespread but declining through habitat destruction (Frank and Reischtuz, in press). Common in broadleaf lowland forest along rivers; lowland and woodland populations threatened by heavy exploitation for export to France (Nawratil, 1969); mountain and forest populations more secure. Considered threatened by hydro-engineering, agriculture, forestry, agricultural pollution and drainage (Frank and Reischutz, in press).
Belgium	S?; declining especially in the provinces of Hainaut, Liege and Brabant, presumably because of over collection although pesticides have also been cited (Leclercq et al., 1984).
Bulgaria	nt; populations healthy.
Czechoslovakia	nt; populations healthy; Slovak distribution mapped by Lisicky (1991); populations in urban, industrial and intensively agricultural areas expanding due ot spread of certain favourable plants (Lozek in litt., 21.3.91).
Denmark	nt; introduced.
Finland	nt; introduced.
France	nt; introduced in the west and occurs naturally in east. However population declines have been reported due to overcollection, mainly for local consumption, and possibly pesticides (Chevallier, 1973).

Germany	R/V; distribution corresponds to calcareous areas; heavily collected for export; declining in Hesse, Schleswig-Holstein and Nordrhein-Westfalen; not threatened in Bavaria (Falkner, 1991); increasing in some places in east.
Great Britain	S?; probably introduced in Roman times; restricted to south (Kerney, 1976; Pollard, 1974); rare but probably not in serious decline although there were fears of local extinctions in the 1970s (Welch and Pollard, 1975); loss of chalk grassland is the main threat, but decline is not considered severe enough for listing in Red Data Book (Bratton, 1991).
Greece	nt?; Scattered populations in eastern Macedonia and Thrace; collected for local consumption and export (Legakis, 1990).
Hungary	nt; but large quantities collected for export (Wells et al., 1983).
Italy	nt; north e.g. Modena (Palazzi, 1983).
Liechtenstein	nt; 35 localities (Trub, 1988).
Luxembourg	nt.
Netherlands	R/nt?; introduced; some populations declining, e.g. in Limburg and some threats from loss of habitat as well as collecting; successfully protected in south (Butot, 1975; in litt. 4.7.90).
Norway	R; Introduced to very few sites, mainly in south.
Poland	nt; but may have disappeared from areas with heavy collecting pressure. Found throughout the country but indigenous to the south only; irregular distribution in the Carpathians; large quantities (300,000-400,000 kg/year) collected for export (Urbanski, 1963; Stepczak, 1986a).
Romania	nt?; found at 800-1000m in wide variety of habitats including parks, gardens and woods; large quantities collected for export; lowland populations said to be declining but since collecting regions are changed each year, probably not threatened nationally; forest and mountain populations largely secure (Wells et al., 1983). Grossu (1983) identifies a number of subspecies.
Spain	?; No information on distribution; collected for local consumption (Wells et al., 1983).
Sweden	nt; introduced; populations healthy in south.
Switzerland	R (4/4); some populations declining, particularly those subject to heavy exploitation. Abundant in limestone, dolomite and marl regions of Alps, Jura and Swiss Plateau but also in regions with siliceous bedrock; demand is such that species is also imported (Wells et al., 1983; Turner, 1990).
USSR	nt?; Ukraine, western districts of Byelorussia and Baltic; introduced Leningrad, Moscow, Kursk, Kiev (Likharev & Rammel'meier, 1962).
Yugoslavia	?; possibly declining; collected for local consumption (Wells et al., 1983).

Conservation

Austria: collecting controlled, listed in Red Data Book (Frank and Reischutz, in press); Belgium: collecting controlled (Wallone); Bulgaria: collecting controlled; Czechoslovakia: collecting controlled; France: collecting controlled; Germany: collecting controlled, listed in Red Data Book for west (Ant & Jungbluth, 1984) and on threatened species lists for Hesse (Jungbluth, 1987), Baden-Wurttembergs (Jungbluth & Burk, 1985), Schleswig-Holstein (Anon, 1982) and Nordrhein-Westfalen (Ant & Jungbluth, 1987); Great Britain: occurs incidentally in protected areas; Hungary: collecting controlled, occurs incidentally in protected areas; may have total protection in 1991 (Richnovsky in litt., 1990); Italy: collecting controlled; Luxembourg:

collecting prohibited without written consent of landowner; Netherlands: exploitation prohibited without written consent of landowner, occurs incidentally in protected areas; Poland: minimum diameter for collecting of 30mm, closed season in June (Stepczak, 1986), occurs incidentally in protected areas; Switzerland: collecting controlled in some areas and prohibited without written consent of landowner, occurs incidentally in protected areas, listed in Red Data Book (Turner, 1990).

Research into the farming potential of this species has been carried out in France, Poland, Netherlands, Austria and Hungary (Wells et al., 1983; Gomot et al., 1988). Most successful enterprises have involved the rearing of juveniles taken from the wild, rather than captive breeding (Wells et al., 1983). The Petit Gris Snail, Helix aspersa, although not considered such a delicacy is now farmed and may take the pressure off H. pomatia populations (although there is some doubt about this (Elmslie in litt., 1991). Further information on farming of this species is available in the journal 'Snail Farming Research', published every two years by the Italian Snail Farmers Association (Associazione Nationale Elicicoltori).

Listed on Appendix III of the Bern Convention and in IUCN Red List (IUCN, 1990). Research on this species should continue to be encouraged, particularly in areas which can provide the necessary data for designing effective management strategies for wild populations and lead to successful captive breeding enterprises. Proposed for European Red List of Threatened Plants and Animals (UNECE, 1989).

Identification Description in Pfleger and Chatfield (1988), Cameron and Redfern (1976); Kerney and Cameron (1979).

Bibliography References up to 1983 in Wells et al. (1983).

Margaritifera auricularia (Spengler, 1793) **ENDANGERED**

Class BIVALVIA **Order** UNIONOIDA
Family MARGARITIFERIDAE

Nomenclature Has been known as M. sinuata in Italy (Giusti in litt., 20.6.90).

Common name Spengler's Freshwater Mussel (Eng).

Biology
Little known, but presumed to be similar to M. margaritifera. All reported occurrences are from large, slow rivers with clean water. In the River Ebro in Spain it favours quiet pools at depths greater than 8m in the main channel. The preferred substrate is pebbles, sand and other mussels, but not silt or mud (Altaba, 1990). This author suggests that the main fish host may be the Western European Sturgeon Acipenser sturio which has a similar, although more extensive distribution, and has also gone a major decline in the last century.

Range
Not known outside the western Palaearctic. Originally in much of western, central and southern Europe but since about 1850 restricted to a few rivers in Portugal, Spain, Italy and France. It was reported erroneously by Ellis (1978) from Switzerland, but this was due to confusion with Unio sinuatus (Turner, 1987). There is a subspecies M. a. maroccana Pallary in Morocco, but this has not been recorded recently despite suitable habitat; known previously from Oeds Fes, Nja and Dai (affluents of Sefrou) and Derna and Redom flowing into the Oum er R'bia (Altaba, 1990).

Status
Reasons for decline uncertain. Like other pearl mussels, it probably has a very slow reproductive cycle coupled with a high longevity. This would cause it to be very vulnerable to heavy exploitation and may account for its widespread disappearance; it may have been collected intensively by early man. Pollution has also been cited as a factor (Wells et al., 1983) and alteration of water courses.

Belgium	Ex; previously occurred in lower Meuse?
Czechoslovakia	Ex (Lozek, 1964).
France	Ex?; previously recorded from the rivers Adour and Arros (in north-west Pyrenees); Tet (north-eastern Pyrenees); Charente; Dordogne, Garonne, lot, Baise and Tarn; Loire and Allier; Somme and Seine, with the Aube, Marne, Oise and Vesle; Saône, Doubs and junction with Rhone in western Alps; Lomme. Already uncommon by 1930 (Germain, 1930/31). No recent records apart from a report of fresh, recent shells in the Loire a few years ago (Dettmer in litt., 1990)
Germany	Ex (Ant & Junbluth, 1984); had disappeared from central Germany (rivers Sale, Unstrut and White Elster) by the mid-15th century and from the upper and middle Rhine and its affluents by the late 16th century (Huckriede and Berdau, 1970).
Great Britain	Ex; recolonised after the last glaciation but subsequently became extinct; a Thames population has been dated to the Neolithic period and may have been exploited by early man; extinction could also have been due to changes in hydrology from forest clearance and increased sedimentation (Altaba, 1990; Ellis, 1978; Preece et al., 1983).

Italy	Ex; not recorded this century (Giusti in litt., 1990; Castagnolo in litt, 1990); previously recorded from river Po and its tributaries Chiese and Mincio, and in Padua. Extinct in central Italy (?Malatesta, 1964).
Luxembourg	Ex (Reuter, 1974).
Netherlands	Ex; previously occurred in lower Meuse and lower Rhine? (?Kuijper, 1988).
Portugal	?; Tagus R?.
Spain	E; previously in Rivers Ebro (S. Catalonia) and Guadalquivir only (Hass, 1916, 1917); Tagus?; currently found only in the Ebro (and R. Tet?) below a series of large dams; sites higher up the river where it used to occur are now impounded. Young mussels are absent possibly through lack of host fish; other threats include the dams, nuclear waste, sewage, toxic waste, loss of river bank forest, water diversion, introduction of exotic fish and potential exploitation. Populations may still exist in the lower Ebro because of its remoteness (Altaba, 1990), but there are some reports that these have also been destroyed (Ross pers. comm., 1991).

Conservation

Spain: May occur within the Ebro National Park as this covers a large part of the Ebro Delta. A petition for the protection of all freshwater mussels was presented to the autonomous government of Catalonia in 1987; the 1989 Plan of Natural Spaces may include it as a strictly protected species. Recommendations for protecton of this and other unionids have been presented to the Ebro Hydrographic Confederation and have been accepted by the Ebro Delta National Park: 1. Collecting to be restricted by a permit system; 2. Further research; 3. Protection of fish hosts; 4. Protection of riparian forest; 5. Education; 6. Establishment of captive breeding colonies; 7. Translocation; 8. Water quality control. Proposed for listing on EEC Habitats Directive.

Listed in Appendix II of the Bern Convention, as Indeterminate in the IUCN Invertebrate Red Data Book (Wells et al., 1983) and as Vulnerable in the IUCN Red List (IUCN, 1990), but new information warrants the category Endangered. Proposed for listing on EEC Habitats Directive and proposed European Red List of Threatened Plants and Animals (UNECE, 1989).

Distribution surveys are needed, followed up by recovery plans and protection of habitats. Ecological studies are required on the host range, since the decline of the host fish may be implicated. Introduction of infected fish could be attempted (Bauer, in litt., 27.8.90).

Identification Ellis (1978); Altaba (in press).

Margaritifera margaritifera (Linnaeus, 1758) VULNERABLE

Class BIVALVIA Order UNIONOIDA
Family MARGARITIFERIDAE

Nomenclature synonym: formerly known as Margaritana margaritifera, Unio margaritifer

Common names Freshwater Pearl Mussel (En); Flussperlmuschel (Germ.); Mulette, Moule d'eau douce (Fr.).

Biology
Prefers soft, calcium-poor water and typically occurs in cold clean swift flowing upland and lowland streams and rivers 0.5-1.5m deep with mixture of stones and sand (non-calcareous bedrock), although in Ireland also found in pH ranging from acidic to highly calcareous (6.5-8.6pH). Virtually sedentary as adults. Depend on fish for parasitic larval stage; host fish is predominantly brown trout Salmo trutta, and other native salmonids such as the salmon Salmo salar; very rarely introduced salmonids (Bauer, 1988; Zyuganov and Nezlin, 1988). The larvae (glochidia) are released in late summer/autumn and reach the host gills passively in water currents; they develop preferentially in young trout, less than 3 years old (Bauer, 1987b, c; Bauer and Vogel, 1987; Bauer, 1991). Two types of life cycle have been identified: one in which glochidia attach to the gills of the host fish between July and September and fall off between May and July the following year, and a second in which the glochidia fall off in October of the same year of attachment (Jungbluth in litt., 19.1.91). Less than ten out of one million glochidia are likely to enter a suitable host (Bauer, 1989b; Young and Williams, 1984).

Young mussels probably spend their early years deep in the river bed. They mature at 15-20 years and adults continue reproducing throughout life. May live for over 100 years, but age seems to vary with latitude; life span is longer in Polar populations (individuals from UK populations may live for 120 years and ones from Sweden and the Arctic for 140-150 years) than in southern populations (Bauer, 1988). Long life-span may be related to a low metabolic rate (Bauer, 1989a). Population density may be as high as 100 individuals per sq.m., and in Sweden up to 400/sq m (Grundelius/Eriksson in litt., 2.5.91). At low population densities, females become hermaphroditic which ensures fertility even in small scattered populations (Bauer, 1987a). Information on the mobility of mussels and their ability to recolonise as adults given in Young and Williams (1983). Additional ecological information on populations in Germany in Baer (1969).

Range
Holarctic: northern Europe, Eurasia and eastern North America, where it is confined to areas east of the Appalachians on the Atlantic coast from Newfoundland, Canada, to Pennsylvania, USA (Walker, 1910; Stober, 1972; Zilch, 1967 (localities based on specimens in Senckenberg Museum)). The exact boundaries of the range seem to be unclear; distribution maps in Jungbluth et al. (1985) and Banarescu (1990) have some differences. In particular, its distribution in Asia is not clear. It is reported not to occur in Siberia, the eastern edge of its range being the basin of the Rover Dvina, in the region of Arkhangelsk. Bouchet (1990) states that there is no information on its status in Asia. Zilch (1967) gives records for Japan and Woodward (1990) reports declining populations in Japan, but it seems more likely that these are M. dahurica (or the genus Dahurinaia) rather than M. margaritifera (Zyuganov in litt., 20.10.90).

Most populations in North America are stable and the species is not listed in any US state or federal threatened species lists although there is a proposal for its listing as 'threatened' in Vermont (Bouchet, 1990; D. Smith in litt., 16.1.91). (Woodward (1990b) states that populations are

declining in USA and Canada including Nova Scotia but gives no details). New England populations are naturally small but healthy (D. Smith in litt., 16.1.91). It was thought that increasingly acidic rainfall and accelerated siltation from land development would endanger them (Wells et al., 1983), but these have had no impact yet, although there have been one or two die-offs, the causes of which are unknown (D. Smith in litt., 16.1.91). In most states, the species is restricted to small streams, which might have limited resources to support a top predator such as the brook trout, the host fish (Smith, 1978), but restocking with fish for sport fishing has maintained host availability (D. Smith in litt., 16.1.91). In Pennsylvania the few disjunct populations are declining; it was found in the early twentieth century in three tributary streams to the Schuykill River system in eastern Pennsylvania but recently was found in only one of the three. Reduction of these populations probably resulted from organic and inorganic pollution and increased siltation. The status of other populations in the lower Hudson River system of south eastern New York is unknown, and indeed these records have never been confirmed (Strayer, 1987).

Status

Once widely distributed throughout northern Europe, but decimated through extensive exploitation for its highly-valued pearls since pre-Roman times, pollution since industrialisation, watercourse alteration and intensification of agriculture (Bjork, 1962; Kerney, 1975; Woodward, 1990b; Falkner, 1991); the decline in Central Europe is thought to be 95% since the beginning of this century (Bauer, 1991). Causes of decline are often locally different; in northern countries pearl fishing tends to be the major problem (Young and Williams, 1983; Woodward, 1990b), whereas pollution is more important in Central Europe (Bauer, 1988; Sackl, 1989).

The main threat in continental Europe is eutrophication. Young mussels can only develop in sediment with low organic content (phosphate, calcium and conductivity are important parameters), and even slight eutrophication increases juvenile mortality. The actual cause of death is not known but may be related to lack of oxygen or increased predation (Bauer, 1991). Many of the remaining populations in Europe are now senescent and no longer reproducing. Adults are less sensitive, but mortality is increased with high nitrate concentrations (Bauer, 1988). However, fertility is independent of environmental factors such as nitrate concentration (Bauer, 1987a), giving good chances of recovery if other factors can be controlled. However, any adverse effects on the trout hosts will also affect the mussel.

These impacts arise from a variety of activities, summarised in Woodward (1990b): acidification (from atmospheric pollution and increased plantation of conifers), which affects host fish and inhibits formation of nacreous layers in young mussels; river engineering and drainage schemes cause increased turbidity of rivers, lowering of water table, and increased nitrate concentrations; hydro-electric schemes alter water courses and cause pollution; similar impacts are felt through agriculture, management of rivers for sport fishing, and fish farming; introduction of exotic fish species for sport, or as escapes from fish farms, may reduce populations of native species.

Austria

E; originally common in upper Austrian Muhlviertel and in tributaries of upper Danube. Extinct in all but a few unpolluted tributaries in western Waldviertel, Lower Austria. The largest population numbers c. 6000 mussels; smaller populations of 50-2500 mussels are known in streams suffering from pollution and eutrophication; total population estimated at 9000-10,000, with very few young mussels (10% of total pop.) (Sackl, 1989). Adults sensitive to increased phosphates in water. Mother-of-pearl industry early this century added to the problems (Modell, 1965; Grohs, 1957 and 1983), but pearl fishing is not currently a problem (Sackl, in litt., 20.9.90).

Belgium
E; seriously declining, probably due to pollution. Occurs in streams and rivers of the Ardennes:- Amblève, Ourthe, Lomme and Lesse. Locally common in the basins of the Semois and Vierre (Adam, 1947). Threatened by pollution in Wallonie, where it is still sought for its pearls (Gaspar et al., 1990). Population of less than 100 individuals near Monschau; may also occur in Belgian part of River Our (Jungbluth in litt., 19.1.91).

Czechoslovakia
E; only six populations still survive, mainly in south Bohemia: Bohemian Forest (Bohmerwald) and Sumava Mtns on border with Germany, L. Posumavi, upper tribs of R. Vltava (Moldav) and R. Blanice. Previously in Upper R. Ohre in Fichtelgebirge but now only on German side; upper Weisse Elster; once in Bohemian Moravian uplands; Black River at Vidnave in Rychlebsky Mtns (Lozek, 1956b). One of the largest European populations (c. 130,000 individuals) occurs in upper R. Blanice, near Volary, with two smaller populations (c. 100 individuals) to the north-east (Trpak, 1989; Trpak, pers. comm. 1990); these populations are threatened by agriculture but appear to have juveniles. The population near Vidnava is the easternmost population in the R. Oder and is nearly extinct; it shows similar characteristics to populations in the Lausitz, Vogtland and Thuringia regions of Germany (Baer, 1984). Bauer (in litt., 7.5.90) suggests that eutrophication, rather than acidification, is the main threat. The population in the Bystrina (Wolfsbach) is also under extreme threat (see under Germany).

Denmark
E/Ex; one population only in River Varde Aa, west Jutland (Bjork, 1962; Hendelberg, 1961; Jackson, 1925), but has not been recorded there since c. 1930 and may be extinct (Baagoe in litt., 1.8.90). But Jensen (in litt. 1.11.82) reported that isolated specimens had been found in 1981 and 1982; this population was threatened by pollution from fish farms and mercury from a drug factory. Main reason for decline has been pollution. Introduced to some rivers (Skern Aa, Sneum Aa, Kongeaaen) but these populations reported to have died out (Jensen in litt, 1.11.82).

Finland
V; declining catastrophically, due to collecting since 1750, pollution and water-course alterations. Now mainly in the north, local in the south-west; distribution map in Valovirta (1990). Confirmed living in only 45 per cent of total known range; known from c. 200 rivers in the early 1900s, but now recorded from only 25% of these (Valovirta, 1990). Population of c. 50,000 in R. Ahtavanjoki (W.Finland) (Valovirta in litt., 4.2.91). Southern populations especially declining, often to only a few hundred specimens. Current total population estimated at 1.5 million, 90% in eastern Lapland. Some of these populations number more than 100,000 individuals but are still considered threatened from peatland drainage (Valovirta, 1990). Pearl fishing had an important impact on populations in the 1950s (Brander, 1956), but became illegal in 1955. Other impacts include floating logs (until the 1970s), clearing and straightening of watercourses, hydro-electric power stations, water pollution from industry, agriculture and residential areas, regulation of water levels and increased siltation (Valovirta, 1990). Recent work carried out through the WWF-Finland/Zoological Museum of the University of Helsinki joint study (Valovirta, 1990).

France
V; strongly declining (Bouchet, 1990). No recent records from Dordogne or Loire Rivers where it was present in 1930s (Germain, 1930), although a 'subrecent' shell was found in the mid-1980s in the Indre, a tributary of the Loire, by Nesemann and Nagel (1989). Still found in small rivers in

Morvan, Massif Central, tributaries of Yonne and basin of Allier (both of these are tributaries of Dordogne and Vienne), Pyrenees and Brittany (Kerney, 1975; Real and Testud, 1980). Recorded from Vosges by Godron (1863) and Germain (1931) but considered extinct here by Bauer (1986).

Germany

E/E; Distribution in last century mapped by von Hessling (1859) and in 1980s, although not yet published, by Jungbluth (in press). Southern populations considered to have declined by 90% (Bauer, 1988), and most populations now lack young mussels (in some populations, the youngest individuals are 60 years old). Once known in 269 rivers in west Germany (Jungbluth in litt., 19.1.910.

Restricted mainly to Bavaria with isolated populations elsewhere - found in 40-50 rivers in Fichtelgebirge and Bavarian Forest (Bauer in litt., 7.5.90); many populations in latter depleted by illegal pearl fishing (Bauer, 1988). In Fichtelgebirge, population of 700,000 mussels recorded by Meissner (1914) now reduced to 20,000 (Bauer, 1979). Relatively stable populations of c. 10,000 individuals in two rivers in north-east Bavaria; a further 10,000 in south-east Bavaria but these have declined in 10 years. Further information on situation in Bavaria in Strecker et al. (1990). Jungbluth et al. (1985) have suggested a total population in Bavaria of 31,000 living mussels, although Bauer (1979) gave a figure of 85,000 for the 1970s.

Distribution in Nordrhein-Westfalen, Rheinland-Pfalz and Saarland given in Jungbluth (1988); once known from 26 rivers in this region but only five populations found recently, all with old individuals and fewer than 500 in each. The species is considered to be extinct in Baden-Wurttemberg and Saarland. In Hesse there is one river with fewer than 25 mussels in the Vogelsberg area. In Nordrhein-Westfalen, the population in Hohes Venn had dropped from 600 mussels in 1988 to 450 mussels in 1990 (Jungbluth in litt., 19.1.91).

Over 3000 mussels are known from one river in Lower Saxony (Boettger, 1954; Bischoff and Utermark, 1976; Dettmar, 1989). Four rivers in Rhine-Palatine have populations, three of which, with about 500 mussels each, are part of the Alfbach/Eifel conservation project (Jungbluth in litt., 19.1.91). A few hundred are known from the Eifel Mtns although many died in summer of 1989. Scattered populations on Luneburger Heide (Bischoff and Utermark, 1976; Dettmar, 1989); used to occur here in rivers draining into Elbe and Weser system; by 1954 extinct in Elbe system except for population in Este, and still occurred in Lachte and Lutter in Weser system (Boettger, 1954). Total population in west Germany estimated at between 35,000 and 150,000 mussels.

In the east, there are now only four populations, three of which are very small and probably no longer reproductively active (Dettmar, in litt. 6.4.90). It is decreasing in south-west Saxony and extinct in east Saxony (Hertel, 1959). In the south, the last remaining large populations were in the Pulsnitz (Dresden region) and Hasel (south-west of Leipzig) rivers (Baer, 1981). There has been a catastrophic decline in populations in the Vogtland mountains (south of Leipzig) where Baer (1970 and 1976) estimated a total population of about 3000 specimens, mainly in the river Weisse Elster and its tributaries, with smaller populations of smaller, thinner shelled, individuals in the Hainbach and Triebelbach. Main threat is pollution, eutrophication having increased noticeably following increased cattle farming; meadow drainage has also become a problem (Baer, 1969). Populations have also declined in Lausitz (Baer, 1969), in Thuringia it is now extinct (Jungbluth in litt., 19.1.91). The largest remaining population in the east (c. 1500-2000 individuals), is in the Wolfsbach on the border with Czechoslovakia. Mussels still produce glochidia, but are threatened by pollution which will not be stopped unless Czech farmers can obtain

compensation from the government (Dettmer in litt., 6.4.90). Additional information on German populations and status in Silkenat et al. (1991) and Reger (1990).

Great Britain

S; very local in north and west Britain, mainly Scotland, and considered to be of regional conservation concern although not included in the national Red Data Book (Bratton, 1991). Distribution maps in Kerney (1976) and Young and Williams (1983). There are scattered records for most of Scotland including Hebrides, Orkney and Shetland, and for the Isle of Man. Not found in east and south-east, south of line from Scarborough to Beer Head. Still occurs in a few scattered rivers in Wales, south-west and northern England (Boycott, 1936; Cranbrook, 1976; Jackson, 1925; Kerney, 1976; Young and Williams, 1983; Negus, 1966).

Although it is still widespread, there is increasing evidence that it is declining (Young and Williams, 1983; Young in litt., 1990; Bratton, 1990), and according to Kerney (1975) it is confirmed living in only 45 per cent of the total known range. Its total known distribution involves only 56 rivers, including those where it is now extinct, and it is not known if it is still breeding at all modern sites (Bratton, 1990). Scotland may still have some of the more important European populations, with abundant juveniles (Woodward, 1990b; Young in litt., 23.10.90). However, pearl fishing by amateurs is a major problem here, e.g. in the Rivers Esk, Spey, Tay and Kerry, and may threaten the future survival of these populations; professional fishermen do not pose a threat as they use a technique to remove pearls that does not injure the mussel. Other threats include pollution caused by throwing dead animals back into river; habitat alteration through river management for salmon fishing and fish farming may be an additional threat (Woodward, 1990b).

Iceland

Unconfirmed and doubtful records (Mandahl-Barth, 1938).

Ireland

V; absent from many suitable sites and declining in many rivers. Confirmed living in only 19 per cent of total known range; distribution map in Kerney (1976) and Ross (1984). Most populations recorded in east and north-east before 1900 are now extinct but a few may survive, still widespread in north-west and west (Ross, 1990) and still occurs in south and south-east (Speight in litt., 1991); probably affected by dredging, pollution and exploitation. Total population c. several millions (Ross, 1990). Population in 23 km stretch of R. Owenea in Co. Donegal numbers c. 200,000 individuals and is fertile but recruitment is very low, with few mussels less than 6 years old. Western Ireland may be major reserve of this species with populations in other rivers as well. Pollution from acid rain and industry not yet a problem but changes in agriculture and afforestation policies may pose a threat (Ross and Roberts, 1989). Pearl fishing a traditional activity in R. Foyle system, but populations and mussel sizes now decreasing (Ross, 1990). The variety M. m. var. durrovensis is endemic to the R. Nore system (formerly in three rivers, now in one), and is unusual for its large size; pop. of less than 5000 individuals is now being studied but is under threat from agricultural pollution (Speight in litt., 1991; Ross, 1990). Survey underway for N. Ireland will clarify current range (Ross, 1990).

Luxembourg

V; Common at beginning of this century but in 1973 shells present in only five rivulets (Troine, Clerve, Wiltz, Sure and Our) and live mussels only in Sure and Our (Reuter, 1974). Currently one population, of c. 3000 in R. Our (Jungbluth in litt., 19.1.91). Pollution a problem.

Norway
V; widespread, mainly coastal but declining from acid rain and pollution, hydro-electric dams and pearl fishing. Distribution mapped in Okland (1976 and 1983). Healthy population of 150,000 invididuals in a river near Oslo (Okland and Okland, 1990). May now be extinct in areas most affected by acid rain, e.g. the south (Kleiven et al., 1989); status in north-east where acidification is also serious is to be investigated (Okland and Okland, 1990). Also threatened by artificial stream regulation and agricultural pollution (Okland and Okland, 1990). Kleiven et al. (1988 and 1989) give additional information.

Poland
Ex?; formerly numerous in Lower Silesia but in decline through pollution (Krakowska, 1978); survey to be carried out.

Portugal
Ex?; reported by Nobre (1913) to occur in R. Tamega (nr Amarante), R. Paiva, R. Sousa (said to be frequent at Paco de Sousa by Nobre (1930)), R. Douro, R. Ferrera, R. Ul at Sao Tiaga de Riba, R. Alentejo and R. Mira. No populations found by Bauer (1986); main cause of decline probably pollution.

Spain
V?; early records from central Spain, Aragon, La Coruna, Lugo and Pontevedra (Servain, 1891) and Galicia (Velado, 1878). Recently recorded from Galicia in R. Landro nr Chavin (mussels short-lived, but population reproducing and stable), in R. Mandeo upstream of Muniferal (population reproducing and stable), and in R. Tambre above Ponte Carreira (mussels reach 60 yrs of age, but no juveniles and may not be reproducing) (Bauer, 1986).

Sweden
V; occurs from Scania to Lapland but depleted by fishing in some areas (Jackson, 1925; Hendelberg, 1961). Drainage of fens and acidification in southern Sweden is a problem. Disappeared from 40-50% of sites inhabited 40-50 years ago. Reproduction poor or failed in most of remaining sites (Grundelius/Eriksson in litt., 2.5.91). Grundelius (1987) considers decline in host fish (trout) populations from acidification to be the most important factor. Only 15-20% of 300 sites visited recently have large populations. One stream in south-east Sweden has 380,000 adults (Henrikson, 15.4.91).

USSR
V; In the European part of the USSR, now found only in undisturbed rivers and streams (Zyuganov, 20.10.90). Large numbers were known from at least 75 rivers in the Kola Peninsula at the beginning of the century but these have been heavily overfished; a population of c. 40-80 million (c. 25 million adults and 15-25 million young) reported from Varzuga R. in 1986/87, a river which is remote with little pollution or log rafting. Smaller but also important populations in the Vadozero basin, the Keret R. (White Sea Basin, Karelia - 3-4 million adults) and Nemina R. (basin of Onezhskoe L.); also in streams in Imandra L. and Laplandsky Preserve; but these sites all threatened by pollution and overfishing (Nezlin et al., 1989; Zyuganov and Nezlin, 1988).). Unconfirmed reports from R. Mituva above Jurbarkas, and Dubysa, both in Lithuania (Woodward, 1990). Has been reported from the Volga watershed and Rivers Don and Dnieper (Jackson, 1925; Jungbluth and Lehmann, 1976) but there are no known modern records of this species from the Don and Dnieper (Zyuganov in litt., 20.10.90).

Conservation

Austria: listed in Red Data Book (Frank and Reischutz, in press). Kamp River is a Landschaft sschutzgebiert (protected country area) but this does not guarantee protection for the pearl mussel (Sackl in litt., 20.9.90).

Czechoslovakia: protected; project underway to manage populations supported by government and regional bodies in south and west Bohemia and north Moravia (Trpak, 1989); Blanice population lies within a 'special conservation status area', negotiated with current land use agencies. Joint projects underway with German workers to protect populations on border and improve management of the Wolfsbach river.

Denmark: protected in September 1990 (Knudsen in litt., 26.7.90).

Finland: Listed in Red Data Book (Rassi and Vaisanen, 1987); collecting prohibited since 1955 but habitat destruction is not controlled. 6 major and several smaller conservation projects have been carried out, supported by WWF-Finland and Ministry of Environment, including prevention of dredging on River Ahtavanjoki; prevention of river bottom clearance which causes drifting of bottom sediments; regulation of pumping near Tampere, S. Finland to stop lowering of water table which causes populations to freeze; combatting illegal pearl fishing; prevention of wintersport developments near populations (e.g. Ounastunturi, W. Lapland); translocation of populations (90% success where populations moved within rivers, 50% success where translocated between rivers); habitat restoration in rivers recovering from log driving (Valovirta, 1990).

France Protected (Bouchet, 1990).

Germany Listed in Red Data Book for west (Ant & Jungbluth, 1984) and on threatened species lists for Hesse (Jungbluth, 1987), Schleswig-Holstein (Anon., 1982), Nordrhein-Westfalen (Ant & Jungbluth, 1987), Baden-Wurttembergs (Jungbluth & Burk, 1985) and Bavaria (Falkner, 1991); protected (but licensed collectors may operate); management and conservation projects underway in Lower Saxony (with Bischoff and Wachtler), Bavaria-Fichtelgebirge (with Bauer), Rhine-Palatine in R. Eifel (with Jungbluth), proposed project for Bavaria -Rhon (with Jungbluth); habitat management plan in preparation for Nordrhein-Westfalen: Hohes Venn (Jungbluth in litt., 19.1.91); in one river, sewage is being diverted around a mussel population through a separate channel (Bauer and Eicke, 1986), and every year c. 50,000 brown trout are infected with glochidia and introduced into various rivers; c. 15 populations are monitored at yearly intervals, reintroduction projects underway on Luneburger Heide (Dettmer, 1989). Zinnbach (tributary of Regnitz) declared a reserve in 1984. Joint efforts underway with Czechoslovakia to protect border populations e.g. Wolfsbach. Plans being developed for a nationwide conservation strategy (Jungbluth, in press). Exhibition and museum being set up in Munich to publicise plight of mussel (Reger, 1990).

Great Britain BRISC (Biological Recording in Scotland Campaign) Scottish Freshwater Mussel Survey currently underway, funded by WWF. Protected under Wildlife and Countryside Act of 1981 (Schedule 5) which makes it an offence to kill or injure the mussel, although pearl fishing may still take place if the pearls are removed from the live animal without damage.

Ireland: fully protectedl pearl fishing permittedonly under licence.

Luxembourg: a conservation project has been submitted to the Ministry of Environment (Jungbluth in litt., 19.1.91).

Poland protected until 1982 when declared extinct.

Sweden protected; listed on threatened species list (Andersson et al., 1987). Projects underway to survey populations and investigate statusand propose conservation measures, funded by WWF-Sweden (Henrikson in litt., 15.4.91).

USSR: listed in Red Data Book; Varzuga river already has some local protection but this is not considered sufficient (Zyuganov in litt., 20.10.90). Major project underway since 1987 in association with work on

salmon host fish; proposals for future work include culturing of glochidia, translocation of adults, and infection of host fish (Zyuganov in litt., 20.10.90).

Listed as Vulnerable in the IUCN Invertebrate Red Data Book (Wells et al., 1983), in the IUCN Red List (IUVN, 1990) and on Appendix III of the Bern Convention. In the USA, listed as 'state rare' in New York and proposal pending to list it as threatened in Vermont but not protected in any other states in which it occurs (Smith in litt., 16.1.91). Proposed for listing on the EEC Habitats Directive and on the European Red List of Threatened Plants and Animals (UNECE, 1989).

Recommendations

As the best documented European threatened mollusc, numerous reports and publications make recommendations for improved management and protection for this species. Bauer (in press), on the basis of knowledge of life history and population dynamics, suggests that conservation activities should be directed as a priority to populations with small shells and short individual life spans as these are likely to go extinct first; the populations with larger shells and long life spans are likely to survive longer. Efforts are already underway to develop multinational projects for this species, including a submission by universities in Germany, Ireland and Scotland to the EEC for a joint research project. The following list is a distillation of the general requirements that are applicable in most countries; it is based on a recommendation for all unionids made to the parties of the Bern Convention by the Group of Experts on the Conservation of Invertebrates in April, 1990.

1. Reduce eutrophication and pollution through strict control measures and monitor water quality (Sackl, 1989; Ross, 1990; Bauer, in press). This is the key requirement for the longterm survival of this species.

2. Create reserves in unpolluted areas where possible and draw up habitat management plans for rivers; Czechoslovakia: the proposed extension of the Sumava National Park does not cover the R. Blanice population, but may prevent the source waters of the river from becoming polluted; the Czech portion of the Wolfsbach river needs protection. Germany: protection needed for populations in Regnitz River basin, where there is potential for a joint reserve with Czechoslovakia. Ireland: R. Nore population of M. m. var durrovensis should be protected (Ross, 1990). Spain: Populations in the rivers Mandeo and Landro and their drainage areas in Galicia, Spain, should be protected as these may be the only healthy remaining southern populations and at present are less affected by pollution and agriculture than other European populations (Bauer, 1986). USSR: proposal underway for establishment of Varzuga R. as a state preserve with recommendations that it should be made a biosphere reserve for salmon and mussels, with proposed introduction of infected salmon and glochidial culture (Netzlin et al., 1989; Zyuganov and Nezlin, 1988).

3. Prevent illegal pearl fishing and publication of exact localities (Bauer, 1988; Ross, 1990). Implement strict controls on licensed fishing. Young mussels under 9 cm in length never contain pearls and should not be fished. With practice a shell may be examined for pearls without destroying the mussel, using tongs. This practice is used by licensed fishermen in Scotland (Young and Williams, 1983) and Germany (Bauer, 1988). Zyuganov et al. (undated) describe additional methods for opening shells without damaging individuals. Draft proposals have been drawn up for controlling pearl fishing in the UK which could be

extended to the rest of Europe (Woodward, 1990). Collecting for research should also be regulated (Woodward, 1990). It may even be desirable to ban pearl fishing, if the control of licenced collecting is difficult.

4. Control engineering activities that alter river banks, water flow and sedimentation (Sackl, 1989; Ross, 1990 and others) and consider liming of streams to halt acidification (cf in Sweden, Henrikson in litt., 15.4.91).

5. Restock rivers with, extend closed season for, and protect Brown Trout where appropriate (Sackl, 1989; Ross, 1990).

6. Reintroduce mussels by introducing fish infected with glochidia to appropriate rivers. Up to 1000 glochidia can develop on a single trout fingerling (Bauer, in press). Investigate potential for captive breeding and re-introduction of the species (Woodward, 1990).

7. Prevent reintroduction of foreign salmonids which may compete with the native host fish (Bauer, 1988).

8. Further surveys are necessary in many countries e.g. Spain (Bauer, 1986), Ireland (Ross, 1990) (work has recently started on the Nore tributaries and other studies are being commissioned (Speight in litt., 1991), France; surveys are being planned for Luxembourg, Germany and Belgium.

9. Improve national protective legislation where necessary (Woodward, 1990); consider adding it to Appendix II of Bern Convention?

10. Co-ordinate research projects underway in Europe and set up centralised data base for the species (Woodward, 1990). In particular, further research is need on the critical juvenile stages.

Identification Pfleger and Chatfield (1988), Woodward (in press), Ellis (1978), Ehrmann (1933), Gloer et al. (1986), Brohmer et al. (1962).

Bibliography Major bibliography in Jungbluth et al. (1985). Comprehensive review of literature to 1983 in Wells et al. (1983).

Microcondylaea compressa (Menke 1829) **VULNERABLE**

Class BIVALVIA **Order UNIONOIDEA**
Family UNIONIDAE

Nomenclature In Italy also known as U. bonelli Michaud.

Common name

Biology
Drains, brooks, rivers and lakes with clean sandy bottoms (Kobelt, 1913). In Switzerland, flowing water and lakes with clear and sandy bottom. Studies on the species life history are under way in Italy (Castagnolo in litt. 25.9.90)

Range
South European; southern edge of the Alps from the river Soca (north-west Yugoslavia) to the upper Po (Northern Italy) (Kobelt, 1913; Lessona, 1880) but distribution not fully known.

Status

Albania	?
Bulgaria	?
Italy	E?; northern, subalpine part of country only (Castagnolo et al., 1980); declining in Lake Lugano (Girod et al., 1977), but may now only occur in the Versa and Vipacco in the province of Gorizia (Castagnolo, in litt. 25.9.90). Once occurred in Modena but not seen in last 10 years (Palazzi, 1983). Nagel and Hoffmeister (1986) provide a recent record for northern Italy.
Switzerland	Ex (Turner and Wuethrich, 1983; Turner, 1990); not rare in the Lugano area in the mid 19th century (Stabile, 1845, 1859). Has disappeared from most areas including Ticino (L. Lugano and R. Tresa) (Girod et al., 1977) as a result of increasing industrialization, population density and intensification of agriculture.
Yugoslavia	K; Southern edge of Alps, from R. Soca in north-west (Pfleger and Chatfield, 1988).

Conservation
Switzerland: listed in Red Data Book (Turner, 1990).
Listed on Appendix III of Bern Convention and in IUCN Red List (IUCN, 1990). Proposed for listing on the EEC Habitats Directive and for European Red List of Threatened Plants and Animals (UNECE, 1989).

Identification Short description in Pfleger and Chatfield (1988).

Bibliography

Pseudanodonta complanata (Rossmassler, 1835) **INSUFFICIENTLY KNOWN**

Class BIVALVIA **Order UNIONOIDA**
Family UNIONIDAE

Nomenclature formerly Anodonta complanata Rossmassler, 1835; A. elongata Holandre, 1836; Pseudanodonta rothomagensis Locard, 1840; P. minima Kennard, Salisbury & Woodward, 1925; three geographical subspecies that correspond to river Danube (P. complanata compacta Haidinger, 1851), Rhine (P. complanata elongata (Holandre, 1836)) and area of northern glaciation (P. complanata complanata (Rossmassler, 1835).

Common Names Compressed River Mussel (Eng.), Abgeplattete Teichmuschel (Ger.)

Biology Found in large quietly flowing rivers and sometimes large streams, canals and lakes (Pfleger and Chatfield, 1988; Ellis, 1978). In Poland found only in very clear, running water (Dyduch-Falniowski in litt., 6.11.89). Main host in wild are perch Perca fluviatilis and sticklebacks Gasterosteus aculeatus and Pungitius pungitius, but other species may be involved (Huby and Wachtler, 1989).

Range North and central Europe from the Elbe in the east to the Weser in the west and to Finland and Sweden in the north (Pfleger and Chatfield, 1988; Fechter and Falkner, 1990).

Status
Sensitive to pollution and declining in many countries.

Austria	E; found only in the Danube in Nieder-osterreich; now extinct in Vienna; ? Vorarlberg; threatened by hydro-engineering, pollution (agricultural, domestic, industrial) and competition with other molluscs (Frank and Reischutz, in press).
Belgium	?; uncommon in Meuse; also in d'Escaut and canals at Campine, Bruges and Ecluse (Adam, 1960).
Bulgaria	?; Danube basin (Frank et al., 1990)
Czechoslovakia	E; sporadic occurence in Labe, Vltava, Danube; Slovak distribution mapped in Lisicky (1991).
Finland	nt
Germany	E/E; fairly widely distributed but rare; among other sites, known from R. Eider near Kiel (Huby and Wachtler, 1989); threatened in Nordrhein-Westfalen, Schleswig-Holstein and Bavaria, Baden-Wurttembergs. Recently found alive in Danube and Rhine but populations threatened (Jungbluth in litt., 15.4.91; Falkner, 1991).
Great Britain	nt.
Hungary	nt.
Norway	R; known only from 10 localities in small area 20-40 km east of Oslo (Okland and Andersen, 1985).
Poland	V/E; declining through pollution and very little suitable habitat left (Piechocki, in litt.; Dyduch-Falniowski in litt., 6.11.90).
Romania	?; Danube basin (Frank et al., 1990)
Sweden	S; occurs in small river and lakes in the south; declining but little known (Andersson et al., 1987)
Switzerland	Ex? (1/-); possibly extinct in Thurgovia; formerly occurred near Etzwilen; in flowing or standing clear water to 11m depth (Turner, 1990).

USSR nt?; widespread in rivers and freshwater inland seas (Zhadin, 1965).

Conservation

Austria: listed in Red Data Book (Frank and Reischutz, in press); Germany: protected; listed in Red Data Book (Ant & Jungbluth, 1984) and on threatened species lists for Bavaria (Falkner, 1991), Schleswig-Holstein (Anon, 1982), Baden-Wurttembergs (as P. elongata) (Jungbluth & Falkner, 1985) and Nordrhein-Westfalen (Ant & Jungbluth, 1986). Sweden: listed in national list of threatened species (Andersson et al., 1987); Switzerland: listed in Red Data Book (Turner, 1990).

Identification Ellis (1978).

Unio crassus Philipsson, 1788 VULNERABLE

Class BIVALVIA Order UNIONOIDA
Family UNIONIDAE

Nomenclature
Three subspecies (Gloer et al., 1985; Brohmer et al., 1956): Unio crassus crassus occurs in north; a large variety U. crassus crassus fa maximus (Kobelt) described from Schleswig-Holstein in some rivers; U. crassus cytherea Kuster, 1836 described from the Danube basin in C. Europe inc. E. Switzerland, middle Danube & Neckar, Austria; U. crassus batavus (Maton & Rackett, 1807) described from W. Europe, inc. Spain, France, W. Switzerland, Rhine, S and S.W. Germany (Jungbluth in litt. 19.1.91 and in Ant and Jungbluth (1987) calls this subspecies U. crassus nanus (Lamarck, 1819).

Common names Bachsmuschel, Kleine Flussmuschel, Gemeine Flussmuschel (Germ.), Dicke Flussmuschel (Liech.).

Biology
Occurs in brooks, large streams and rivers with gravel or sandy to muddy bed; requires running, clean water (Pfleger and Chatfield, 1988; Turner, 1990). May also occur on shores of lakes with running water (Fechter and Falkner, 1990). Reproductive biology, hostfish preference and glochidial abundance described in Engel and Wachtler (1989) and Wachtler (1989). Does not appear to be able to reproduce at low densities, unlike Margaritifera margaritifera. Maximum age is 12-15 years (Bjork, 1962), but maximus variety grows more rapidly (Engel and Wachtler, 1989). maximus variety produces far more glochidia than the normal form. Adam (1960) describes differences in reproduction between subspecies U. c. crassus and U. c. batavus; former lives in softer water than latter. The sticklebacks Gasterosteus aculeatus and Pungitius pungitius are both important host fish (Engel and Wachtler, 1989); other hosts include Bullhead Cottus gobio and Minnow Phoxinus phoxinus in Bavaria (Hochwald, 1988 & 1989) and perch Perca fluviatilis and chub Leuciscus cephalus, and for the maximus variety, rudd Scardinius erythrophthalmus and dace Leuciscus leuciscus (Engel and Wachtler, 1989).

Range
Central and Northern Europe (excluding Great Britain); extends to Black Sea.

Status
Now considered the most threatened European mussel after Margaritifera margaritifera (Bauer in litt., 3.11.89) although its decline went unnoticed for a long time. Threatened mainly by eutrophication from agricultural run-off, particularly manure, and sewage. Ammonia content in sediment is a critical factor in limiting its survival (Engel, 1989), and nitrogen content must be less than 10mg/l for successful growth of juveniles (Hochwald, 1989). Decrease in host fish density may also be a threat.

Austria — E; formerly abundant in pre-alps of Salzburg, Upper and Lower Austria (used as pig food); but only six viable populations (5 in Carinthia, 1 in Lower Austria (now extinct) reported since 1975 - scattered living specimens found at 16 sites (6 Carinthia, 8 Lower Austria, 1 Styria and Upper Austria), cf. 100 known sites before 1975. Reported to have been abundant in Kamp, Thaya and Krems rivers in the Waldviertel earlier this century but only a few scattered specimens found now. Host fish Bullhead and Minnow also declining; other threats probably include river engineering, pollution and eutrophication (Sackl in litt., 20.9.90; Frank and Reischutz, in press).

Belgium	?; probably threatened (Hochwald in litt., 3.11.89); recorded from Haute and Moyenne Belgique but rare in Basse-Belgique (Adam, 1960).
Bulgaria	?; occurs in Danube (Frank et al., 1990).
Czechoslovakia	R/V?; Labe, Tisza, Hornad (Steffek, in litt., 1990; Trpak, pers. comm., 1990); Slovak distribution mapped in Lisicky (1991).
Denmark	?; threatened (Hochwald in litt. 3.11.89)
Finland	V; found in south to south-west; declining from habitat loss and pollution; on edge of range (Valovirta in litt., 4.2.91).
France	nt; (occurs throughout the Loire drainage (Nesemann and Nagel, 1989)).
Germany	E/V; decline noticed as early as 1950s (Jaeckel, 1952) and has become more rapid in recent years (Wiese, 1984). Northern and southern populations being surveyed. 7 populations in Hesse of which two are good and could survive with habitat management; probably fewer than 30 populations in Baden-Wurttemburgs and mainly no juveniles (Jungbluth in litt., 19.1.91). Population at Schleswig Holstein no longer reproducing; population in Saxony reproducing but threatened (Engel, 1989). In Bavaria, only 10 populations remaining of the 27 populations known according to (Hochwald, 1989; Hochwald and Bauer, 1988,1989) but 28 populations in 237 rivers, of which 5 populations are stable, according to Jungbluth (in litt., 19.1.91). 7 out of 18 populations left in Oberfranken (Hochwald, 1989). A recent find at Isar-Stanstufe Landau indicates a population with different characteristics (?) (Falkner, 1991). Probably only one remaining healthy population, 99% of pops having died out (Bauer in litt., 3.11.89). Important population in Regnitz and its tributaries. Further information on populations in Hesse, Bavaria and Baden-Wurttemburgs in a series of reports by Jungbluth, Gerber and Groh. Also threatened by decline in hostfish (Hochwald, 1989) which are listed in Red Data Book.
Hungary	nt.
Liechtenstein	R; one locality in Ruggeller Riet nature reserve (Trub, 1988).
Luxembourg	V; small population in R. Our with no juveniles (Jungbluth in litt., 19.1.91).
Netherlands	E; River Meuse only (Butot in. litt., 1990)
Poland	E; rapid decline over last 30-40 years and now very rare (Dyduch-Falniowska, 1989 and in litt., 6.11.90).
Romania	?; occurs in Danube (Frank et al., 1990).
Sweden	S/V; south-east, from Scania to Dalaina, but very scattered (von Proschwitz in litt., 29.11.90); on edge of range; in rivers with good flow; threatened by pollution, eutrophication, hydro-engineering (Andersson et al., 1987).
Switzerland	E (1/1); declining (Turner, 1990)..
USSR	nt?; widespread, east to Arkhangelsk (Zhadin, 1965).

Conservation

Austria: listed in Red Data Book (Frank and Reischutz, in press); Finland: proposed for 1991 edition of Finnish Red Data Book. Germany: protected; studies underway supported by WWF; listed in Red Data Book for west (Ant and Jungbluth, 1984) and candidate species for Red Data Book for east (Von Knorre, 1990); on threatened species lists for Hesse (Jungbluth, 1987), Schleswig-Holstein (Anon., 1982), Nordrhein-Westfalen (Ant & Jungbluth,

1987), Baden-Wurttemburgs (Jungbluth & Burk, 1985) and Bavaria (Falkner, 1991). Sweden: listed on national threatened species list (Andersson et al., 1987); data sheet compiled for National Swedish Environment Protection Board (von Proschwitz in litt., 29.11.90). Switzerland: listed in Red Data Book (Turner, 1990).

Listed in IUCN Red List (IUCN, 1990) and proposed for UNECE Red List of Threatened Plants and Animals (UNECE, 1989). Proposed for listing on EEC Habitats Directive, and should be added to Bern Convention as soon as possible.

Identification Gloer et al. (1985), Brohmer et al., 1956; Pfleger and Chatfield (1988).

Further information in Jaeckel (1952), Nesemann (1989), Hochwald and Bauer (1988, 1990) and Tudorancea & Gruia (1968).

Unio elongatulus Pfeiffer 1825 VULNERABLE

Class BIVALVIA Order UNIONOIDEA
Family UNIONIDAE

Nomenclature Zilch (1967) lists 21 subspecies; Haas (1969) gives 17 geographic subspecies. Unio mancus Lamarck (also known as U. glaucinus vulgaris) is probably the subspecies U. elongatulus mancus Lamarck, 1819 in Italy. Altaba (in press) discusses four ssp from the Catalan region of Spain: U.e. aleroni Companyo & Massot, 1845; U.e. penchinatianus Bourguignat, 1865; U.e. ibericus Altaba, in press; U.e. valentinus Rossmassler, 1854. May be synonym of U. requieni (Michaud, 1831).

Common name None known

Biology
Rivers, streams and clean lakes (Altaba, in press); generally requires running water rich in oxygen; also found in lakes with sandy bottoms (Girod et al., 1977; Girod in litt. 3.3.84 to H. Turner). Reproductive cycle described in Castagnolo (1977); glochidia released from spring throughout summer.

Range
Circum-mediteranean (Altaba, in press; Badino, 1980); southern Switzerland, southern France, Italy, Balkan Peninsula and other Mediterranean countries (Zilch, 1967).

Status

France — K; occurs in Loire valley but taxonomic confusion between U. pictorum and U. e. mancus: intermediate forms found at several sites but U. e. mancus occurs most often in upper and middle parts of valley (Nesemann and Nagel, 1989). Recorded by Zilch (1967) from R. Saone, R. Rhone. Aube and E. Pyrenees. It has been suggested that the endemic U. turtoni in Corsica may be a subspecies of U. elongatulus but further work is required.

Italy — I; originally occured throughout peninsular Italy and most of the islands, including Sardinia (Castagnolo et al., 1980; Haas, 1969). Zilch (1967) mentions Etsch by Calliano, Mincio, Mantua, L. Cumai and R. Tiber. There is much taxonomic confusion now and its current distribution is not known: many workers use U. mancus for this species but Castagnolo (in litt., 25.9.90) believes that there is a single species, U. elongatulus. Fondi et al. (1984) record this occurring in L. Maggiore, lakes near Como, Pi Tolle, Staggia and Paglia, but suggest that a different Unio species may occur in the south in L. Bradano. U. elongatulus mancus declining in Lake Lugano (Girod et al., 1977). Recorded in Lago di Comabbio (Varese), Lago di Ghirla (Varese) and Lago di Montorfano (Como) by Annoni et al. (1978). There was a good population in one of the main branches of the delta in Po di Tolle in the 1970s (Castagnolo, 1977). Occurred in Modena but not seen in last 10 years (Palazzi, 1983). A population of U. mancus in a small canal in Pavia, near Voghera, had a density of more than 100 mussels/sq m, but may be in decline as older individuals predominate (Nardi, 1972 a and b).

Spain — I; U.e. aleroni occurs in north-east Catalonia from the Corbieres Range to the Tordera River. U.e. penchinatianus endemic to L. Banyoles and is rare and vulnerable to alterations of the lake. U.e. ibericus is restricted to R. Ebro and adjacent canals in Catalonia and Aragon. U. e. valentinus occurs around the Gulf of Valencia. All subspecies in the Catalan region are considered to be in regression (Altaba, in press).

Switzerland — V; seriously declining (Turner and Wuethrich, 1983; Turner, 1990). Recorded in Lago di Muzzano (canton Ticino) and in the river Doubs (canton Jura) in the 19th century and in the first decades of the 20th century (Stabile, 1845, 1859; Geyer, 1927; Schnitter, 1922) but now extinct as a result of waste water discharges into the former (Girod and Bianchi, 1977) and only found as dead shells in the latter near St Ursanne (P. Saunier in litt. 4.3.87 to H. Turner).

Yugoslavia — K; Zilch (1967) lists localities in Dalmatia and Montenegro.

Conservation

Switzerland: listed in Red Data Book (Turner, 1990).
Listed on Appendix III of Bern Convention and in IUCN Red List (IUCN, 1990); proposed for EEC Habitats Directive and European Red List of Threatened Plants and Animals (UNECE, 1989).

Identification Haas, 1969; subspecies from Catalan region described by Altaba (in press).

Pisidium pseudosphaerium Schlesch, 1947 OF SPECIAL CONCERN

Class BIVALVIA Order VENEROIDA
Family SPHAERIIDAE

Nomenclature

Common names False Orb Pea Mussel (Eng.); Flache Erbsenmuschel (Germ.)

Biology
In Great Britain, lives in marsh drains and ponds. Its habitat is specialised and essentially of transient character: clear, clean water in stagnant places choked with aquatic plants, often over a richly organic, even anaerobic, bottom; in southern England often with other rare relict molluscs e.g. Valvata macrostoma, Anisus vorticulus and Segmentina nitida (Bratton, 1991). In Poland, found in lowlands, max. alt. 500m a.s.l., in stagnant waters; rare in rivers; also in peat bogs, marshes and flooded meadows; often found with A. vorticulus, and Gyraulus riparius (Piechocki, 1989). Similar habitat in France (Mouthon & Kuiper, 1987) and Germany (Falkner, 1991).

Range
Central and Western Europe, mainly in lowlands between the Alps and south Scandinavia; discontinuous distribution between 44 deg. N (Toulouse) and 63 deg. N (Jamtland) and 7 deg. W (Dublin) and 31 deg. E (Leningrad). Rare in northern Europe, occurring mainly in the south (Kuiper, 1972; Kuiper et al., 1989). Mainly a lowland species, becoming rarer in mountains.

Status
Kuiper (in litt., 1990) believes this species is not threatened at the regional level given its typical pea mussel characteristics, but it is included here because of the number of countries in which it is considered nationally at risk.

Austria	E; Karnten, Oberosterreich; threatened by forestry, recreational activities, drainage (Frank and Reischutz, in press).
Belgium	?
Czechoslovakia	S; very scattered distribution (Steffek, 1987); mapped in Lisicky (1991).
Denmark	?; scattered distribution (Kuiper et al., 1989)
Finland	R; on edge of range; south-west and southern marshes but rather few sites (Kuiper et al., 1989).
France	V; three areas only (Mouthon & Kuiper, 1987); threatened by habitat destruction
Germany	?/E; endangered in east; isolated localities in north & south; threatened in Bavaria (Falkner, 1991).
Great Britain	R; widely separated populations known from E. Sussex, Middlesex, E. Suffolk, Monmouthshire, Herfordshire, Cheshire and Northwest Yorkshire (Kerney, 1976) and more recently Lincolnshire. Threatened by drainage, 'improvement' or elimination of stagnant ponds and ditches, eutrophication, but may be under-recorded (Bratton, 1991).
Hungary	R; Petnehaza, Takos.
Ireland	V; local, in eastern midlands; two localities only in Royal Canal (Westmeath and Kildare) and Lagan Canal (Antrim). Threatened by drainage.
Italy	R; one locality only in north (Kuiper in litt., 1990).

Netherlands	R; pools, marshes and ditches in peat bogs; prefers sandy bottom and freshwater rich in nutrients. Not known from Gelderland, Zeeland, Limburg or Wadden Is.
Norway	R; known only from three small rich lakes in the south-east; at the northern limit of its range (Okland and Kuiper, 1990).
Poland	E; threatened by peat bog drainage (Piechocki, in litt., 1984); scattered distribution, mapped in Piechocki (1989 and in press).
Sweden	nt.
Switzerland	V (2/2); found in a few shallow waters, lakes and marshes (Turner, 1990).
USSR	?; although range reportedly extends to Leningrad, not listed in Zhadin (1965).

Conservation
Austria: listed in Red Data Book (Frank and Reischutz, in press). Germany; listed in Red Data Book (Ant & Jungbluth, 1984) and on threatened species list for Bavaria (Falkner, 1991). Great Britain: listed in Red Data Book; occurs in two National Nature Reserves and an SSSI (Site of Special Scientific Interest) (Bratton, 1991). Poland: occurs in Wielkopolski National Park (Piechocki, 1989). Switzerland: listed in Red Data Book (Turner, 1990).

Identification Ellis (1978); Gloer et al. (1985); Adam (1960); Janssen and Vogel (1965); Zeissler (1971).

Pisidium tenuilineatum Stelfox, 1918 **OF SPECIAL CONCERN**

Class **BIVALVIA** Order **VENEROIDA**
Family **SPHAERIIDAE**

Nomenclature

Common names Fine-lined Pea Mussel (Eng.), Gelbe Erbsenmuschel (Ger.).

Biology
In Great Britain, found mainly in canals and lowland rivers, occasionally large ponds; numbers usually low at any site (Bratton, 1991). Prefers clear small streams on plains and littoral zone of lakes, rarely above 500 m altitude (Kuiper *et al.*, 1989). Reported also to occur in limestone springs on continent (Bratton, 1991). In Scandinavia found in small rivers, brooks and lake shores (von Proschwitz *in litt.*, 29.11.90).

Range Western Palaearctic: from Mediterranean to southernmost Sweden but considered rare. Rarely collected in large numbers (Ellis, 1978; Kuiper *et al.*, 1989). Has also been recorded from Morocco (Atlas Mtns, 1700m a.s.l.), Israel, Jordan (Kuiper, 1981). Is a Pleistocene Interglacial fossil (Ellis, 1978).

Status
Sensitive to water pollution (Piechocki, 1989; Mouthon, 1981), but as with all pea mussels, it is difficult to know its true status because of the erratic nature of its populations.

Austria	V; Salzburg and Karntern; threatened by hydraulic engineering, eutrophication and other agricultural pollution, industrial and domestic pollution (Frank and Reischutz, in press).
Belgium	Ex?; might possibly still occur in Limburg??? (Adam, 1960)
Czechoslovakia	V/E; sporadic distribution in Slovakia: Labe, Slovak karst (Steffek *in litt.*, 1990); distribution mapped in Lisicky (1991).
Denmark	R; single locality at Skjern A, Jylland (Kuiper *et al.*, 1989).
France	nt
Germany	?/K; fairly widespread although not common and absent from N. Saxony and Schleswig-Holstein; threatened in Bavaria (Falkner, 1991), Baden-Wurttembergs and Nordrhein-Westfalen; status not known in east but may be threatened.
Great Britain	R; scattered localities mainly in central, south England and Welsh Borders (Kerney, 1976). Extinct in many places and only dead shells found in recent years despite deliberate searching, and although associated *Pisidium* species have remained unaffected; also extinct in type locality (Bratton, 1991).
Hungary	R; Kislod, Vonyarcvashegy
Italy	nt; but not very common; occurs in L. Mergozzo (Varese, Lombardy) and in region around Gorizia (Castagnolo *et al.*, 1980).
Poland	S?: one of the rarer species and sensitive to pollution but can still be found at some sites in high densities (Piechocki, 1989; Piechocki in press).
Sweden	E; three localities only in south and not recorded since 1940s: Stensjon (Smaland), Nossan (Vastergotland) and Vattern (Kuiper *et al.*, 1981); on edge of range and threatened by eutrophication and habitat destruction (not listed in Andersson *et al.*, 1987).

Switzerland	nt?; (but restricted to lowlands: lakes of Biel, Constance, geneva, Lucerne, Neuchatel, Sarnen, Walendstadt, Zurich (Turner & Wuethrich, 1983).
USSR	nt?; (poorly known but recorded from S. Bug, Don and Volga River basins (Zhadin, 1965).
Yugoslavia	?

Conservation

Austria Listed in Red Data Book (Frank and Reischutz, in press Germany: on threatened species lists for Bavaria (Falkner, 1991), Baden-Wurttemburgs (Jungbluth and Burk, 1985) and Nordrhein-Westfalen (Ant & Jungbluth, 1987); candidate for Red Data Book for east. Great Britain: listed in Red Data Book (Bratton, 1991) and occurs in an SSSSI (Site of Special Scientific Interest). Sweden: data sheet compiled for National Environment Protection Board.

Identification: Ellis (1978); Piechocki (1989), Gloor et al. (1985); Adam (1960), Janssen & Vogel (1965), Zeissler (1971).

Sphaerium rivicola (Lamarck, 1818) **OF SPECIAL CONCERN**

Class **BIVALVIA** Order **VENEROIDA**
Family **SPHAERIIDAE**

Nomenclature Synonym Cyclas rivicola Lamarck, 1818

Common names Nut Orb Mussel (Eng.); Flusskugelmuschel (Ger.)

Biology
Common in all types of stagnant or sluggish water at low altitudes, preferably in muddy beds near the bank (Pfleger and Chatfield, 1988; Ellis, 1978). In Poland, mainly in large and medium-sized rivers with sand/mud bottoms; also found in lakes but only in littoral zone. Can be very abundant under favourable conditions (Piechocki, 1989).

Range Central and eastern Europe.

Status
Kuiper (in litt., 1990) believes this species may be Vulnerable, although it is still considered not threatened in several countries.

Austria	E; in Oberosterreich, Niederosterreich, Vienna (Ex); threatened by hydro-engineering, pollution (agricultural, domestic, industrial), drainage, (Frank and Reischutz, in press).
Belgium	nt?
Bulgaria	?; occurs in Danube (Frank et al., 1990).
Czechoslovakia	?; occurs in Danube (Frank et al., 1990) and in scattered localities; Slovak distribution mapped in Lisicky (1991).
France	R; scattered localities in rivers in north, below 300m (Mouthon & Kuiper, 1987)
Germany	E/E; scattered distribution in centre and north and ? in Rhine valley to south-west; threatened in Hesse, Bavaria (where range in Danube has expanded but still considered at risk), Schleswig-Holstein and Baden-Wurttemburgs; threatened in east by pollution.
Great Britain	nt.
Hungary	nt.
Netherlands	nt?
Poland	V?; but according to Piechocki (1989) still common and probably not threatened in near future. Found in R. Vistula, Odra, and rivers discharging directly into Baltic Sea; commoner in larger rivers but also found in small rivers and some lakes; not found in mountains or uplands (Piechocki, 1989).
Romania	?; occurs in Danube (Frank et al., 1990).
USSR	nt?, widespread

Conservation Austria: listed in Red Data Book (Frank and Reischutz, in press). Germany: listed in Red Data Book for west (Ant & Jungbluth, 1984) and candidate species for Red Data Book for east; on threatened species lists for Hesse (Jungbluth, 1987), Schleswig-Holstein (Anon., 1982), Nordrhein-Westfalen (Ant & Jungbluth, 1987), Baden-Wurttemburgs (Jungbluth & Burk, 1985) and Bavaria (Falkner, 1991).

Identification Piechocki (1989); Pfleger and Chatfield (1988); Ellis (1978); Janssen & Vogel (1965).

Sphaerium solidum (Normand, 1844) OF SPECIAL CONCERN

Class BIVALVIA Order VENEROIDA
Family SPHAERIIDAE

Nomenclature formerly Cyclas solida

Common names Solid Orb Shell (Eng.); Dickschalige Kugelmuschel (Ger.)

Biology
In Poland, characteristic of large rivers where it inhabits places with sandy or sandy-muddy bottom; in main current and at banks. Can also inhabit coarse sands in sites of fast waterflow (Piechocki, 1989). May burrow in substrate to avoid desiccation (Wolff, 1970). Also occurs in old river beds, large lakes and channels and canals (Zhadin, 1965; Wolff, 1970; Redshaw and Norris, 1974; Mouthon & Kuiper, 1987). In Great Britain, found in main river channel and in deep drains opening into river via sluices; relatively high turbidity but rich in other mollusc species (Redshaw and Norris, 1974; Bratton, 1991).

Range Mainly a Central and Eastern European species and reported to be local in all countries where it occurs (Bratton, 1991).

Status
According to Thiel (1929), S. solidum is very sensitive to water pollution but Wolff (1970) suggests it tolerates this comparatively well. Work in Poland suggests that pollution does have a negative affect (Piechocki, 1989).

Belgium	nt?.
France	R; scattered localities in north (Mouthon & Kuiper, 1987)
Germany	E/E; north and central, rare; threatened in Hesse, Baden-Wurttembergs, Schleswig- Holstein, Bavaria (may be extinct) and Nordrhein-Westfalen; threatened by pollution in east.
Great Britain	E; found only in 15 km stretch of R. Witham, Lincolnshire, found in 1968 but only recognised as this species in 1973 (Kerney, 1976; Bratton, 1991; Redshaw and Norris, 1974). No immediate threat but the small population is vulnerable to pollution (Bratton, 1991).
Netherlands	nt?
Poland	R/E (Piechocki, in litt.); declining due to increased pollution and eutrophication; one of rarest freshwater molluscs in Poland but at turn of century was relatively common and numerous. Previously occured in Odra, Warta and Vistula rivers and in Szczecin and Vistula firths; recently recorded in rivers Biebrza, Narew and Bug and in Zegrzynski barrage lake. Probably extinct in Odra, Warta, lower Brda, lower Vistula and Vistula firth, due to pollution. Comparatively rich populations in eastern Poland (Piechocki, 1987 and 1989). Distribution map in Piechocki (1989).
USSR	nt?; occurs from Urals to Ponto-Caspian River basins (Zhadin, 1965).

Conservation Germany: listed in Red Data Book for west (Ant & Jungbluth, 1984), proposed as candidate for Red Data Book for east, and on threatened species lists for Hesse (Jungbluth, 1987), Schleswig-Holstein (Anon., 1982), Nordrhein-Westfalen (Ant & Jungbluth, 1987), Baden-Wurttemburgs (Jungbluth & Burk, 1985) and Bavaria (Falkner, 1991). Great Britain: listed in Red Data Book (Bratton, 1991).

Identification Piechocki (1989), Ellis (1978), Pfleger and Chatfield (1988), Janssen & Vogel (1965).

CONSERVATION

Habitat protection and management

The last decade has seen a growing awareness of the need for invertebrate conservation. Certain 'flagship' species, such as Margaritifera margaritifera have attracted the attention of major conservation bodies like the World Wide Fund for Nature (which has supported pearl mussel projects in Scotland, Finland and Sweden), and there are a growing number of nationally funded mollusc conservation projects. In a few countries, molluscs have even played a role in more general conservation planning: in Czechoslovakia (Steffek, 1988) and Malta (see data sheet), molluscs are being used in developing a system of protected areas. The priorities are clearly habitat protection and management, but for many species there still needs to be more survey work and research to determine their requirements.

Protected areas

There are very few instances of protected areas being created specifically for a mollusc. In France, one site (the Reserve biologique de Sauve in Gard) has been protected for its groundwater fauna which includes a hydrobiid Moitessieria rolandiana (Bouchet, 1990). In Italy, the helicid Ciliellopsis oglasae, endemic to Montecristo Island in the Tuscan Archipelago, is protected, since the entire island has been declared an 'integral natural reserve of European interest' on account of its unusual fauna and flora (Giusti and Manganelli, 1990). In fact, many threatened mollusc species probably occur within protected areas but this is poorly documented. Sites with rare molluscs often support rich and unusual communities of wildlife, with scarce plants, vertebrates and other invertebrates, and thus may have been protected for other reasons. In a few countries, such as Finland, where 21 of the 50 protected areas have now been surveyed for their molluscs (Valovirta, 1991), efforts are being made to obtain such information.

Okland and Okland (1991) and Speight et al. (1991) discuss criteria for using invertebrates such as molluscs in identifying important sites for protection in Europe, in particular the problem of marginal populations, i.e. populations on the edge of a species range. Thus many molluscs are categorised as 'Rare' in Norway, but are essentially the northernmost populations of more widely distributed species. This issue will need further work. Speight et al. (1991) also suggest that national endemics are not necessarily of international importance, although this is not a view taken by all conservation bodies; IUCN in fact lists many national endemics in the Red List if they are under threat.

Often only a small area may required to protect a mollusc population. Bouchet (1990) stresses the potential role that Zones Naturelles d'Interet Ecologique Faunistique et Floristique, small protected areas that can be designated in France, could have in the protection of threatened molluscs. The SSSIs (Sites of Special Scientific Interest) could play a similar role in Great Britain (Bratton, 1991). However, it must be remembered that often the habitat itself cannot be maintained if the area involved is too small (Speight et al., 1991); if the surrounding area is altered this may have profound affects on microclimates, vegetation and other aspects of a small protected area.

Recovery Programmes

Recovery Programmes document the actions that are required to ensure self-sustaining populations of threatened species. Priorities can be set from the level of threat, the recovery potential of the species and the

estimated budget for a species recovery. Programmes like this have been drawn up for a number of threatened molluscs in the USA, and are starting to be used in Europe. For example, a recovery programme has been drawn up for all the British species protected under the 1981 Wildlife and Countryside Act, including Myxas glutinosa and Catinella arenaria (Whitten, 1990). Work carried out on some of the European unionids, particularly Unio crassus and Margaritifera margaritifera, is leading to the development of recovery programmes for these species. In many instances, these will need to be joint endeavours between countries; thus Czechoslovakia and Germany have been collaborating on the management of unionid populations in streams and rivers along their joint borders, and there is growing interest in broader regional efforts to carry research on these species.

General habitat management

Much of the general habitat management carried out now to improve conditions for native wildlife will benefit molluscs, but for many species this may require sound knowledge of their ecology. Efforts to prevent and control pollution are particularly important for many freshwater species, as the creation of protected areas or the implementation of other conservation measures will be of little avail if the species if the source of pollution is not stopped. Experimental work has suggested that application of lime to streams and water bodies can reverse the impact of acid pollution on some molluscs (Walden et al., 1989).

National Legislation

Legislation is usually applied only to species large enough for reasonable identification by non-specialist, as for example, in France, and invariably refers to collection and/or trade rather than habitat protection. For example, there is much legislation to regulate collection of Margaritifera margaritifera, but almost none to protect its habitat or control the pollution which is one of its main threats (see Table 4). For example, the Wildlife and Conservation Act in Great Britain lists protected species on its Schedule 5, but is not specifically habitat oriented. However, such legal protection can indirectly lead to site protection through public awareness and support, it allows prosecution, and increases the chances that sites are notified as SSSIs if a protected species occurs within them. The most threatened species are often very small and so legislation covering habitat protection is essential. Thus, Bouchet (1990) has proposed 30 hydrobiid species for protection in France, the focus of this protection to be the preservation of the springs and improvement of the groundwater quality in the areas in which they live.

Red Data Books and threatened species lists

These can play a valuable role in stimulating public awareness and in defining priority species for attention.

National Red Data Books

Many national Red Data Books and threatened species lists now include molluscs. They provide important information at the national level and play a useful role in promoting invertebrate conservation priorities. In addition to the countries listed below, several others, such as Poland, have now initiated the process of listing threatened molluscs.

Table 2. Red Data Books and threatened species lists with molluscs

Austria	Frank & Reischutz (in press); also Kuhnelt (1983)
Steiermark	Gepp (1981)
Finland	Rassi & Vaisanen (1987); new edition in preparation
Germany	Ant & Jungbluth (1984)
Baden-Wurttembergs	Jungbluth & Burk (1985)
Bavaria	Falkner (1982); proposals for revision in Burk and Jungbluth (1986) and Falkner (1991)
Hesse	Jungbluth (1987)
Lower Saxony	Jungbluth et al. (1989) = proposal
Nordrhein-Westfalen	Ant & Jungbluth (1987)
Schleswig-Holstein	Anon. (1982)
former GDR	list in preparation
Great Britain	Bratton (1991)
Hungary	Rakonczay (1990)
Malta	Thake & Schembri (1989)
Sweden	Andersson et al. (1987)
Switzerland	Turner (1990)
USSR	Bannikov & Solokov (1984); revised edition in preparation will include many more species (Kochetova in litt., 1991)
Yugoslavia	in preparation in 1983, but not recent information (Kolaric in litt., 22.8.83)

IUCN Red List

The IUCN Red List of Threatened Animals (IUCN, 1990) lists those taxa considered by IUCN to be globally threatened. It is not a comprehensive list and probably only a small proportion of the world's globally threatened molluscs are included. A total of 425 molluscs are listed, compared with 698 mammals, 1047 birds, 254 reptiles and amphibians, 762 fish and 1825 other invertebrates, mainly insects. Table 3 shows the European molluscs listed. These comprise 22 endemic Tenerife gastropods, 16 endemic Madeiran gastropods, 29 hydrobiids, 32 other gastropods, and 5 unionids.

As discussed in the recommendations, this list should be revised according to the new information gathered in this report.

UNECE European Red List of Threatened Animals and Plants

The UN Economic Commission for Europe covers a much broader range than the EEC, extending to Turkey and the European part of the USSR. It s organisation has initiated a number of strategies and mechanisms to conserve the living and natural resources within its remit. These include the identification of species that occur in Europe and are considered globally threatened. The proposed Red List is based on the European species listed on the IUCN Red List and thus includes a much larger number of species than those listed on the Bern Convention or EEC Habitats Directive. All the European non-marine mollusc taxa listed in IUCN (1990) have been proposed for listing.

The UNECE Red List is still in draft form (UNECE, 1989). Actions to complement the list are being developed and will include its updating and improvement and the preparation of guidelines or a code of practise on its use for ECE governments. The latter will cover: a) regulation of exploitation to ensure that it is sustainable, b) regulation of killing and disturbance of listed species, c) regulation of trade, d) introduction of

Table 3. European molluscs on international treaties and lists

N.B. UNECE list and EEC Habitats Directive are proposals only at the time of writing.

Letters = IUCN category; numbers = annex

	This Report	IUCN Red List	Bern Conv.	UNECE List	EEC Hab Direct
29 hydrobiids					
Arganiella exilis (France)	I	I		I	
Avenionia brevis (Neths, Belg, Fr, Germ)	K	I		I	
Belgrandiella pyrenaica (France)	I	I		I	
Bythinella bicarinata (France)	I	I		I	
B. carinulata (France)	I	I		I	
B. pupoides (France, Switz)	I	I		I	
B. reyniesii (France)	I	I		I	
B. vesontiana (France)	I	I		I	
B. viridis (France)	I	I		I	
Bythiospeum articense (France)	I	I		I	
B. bressanum (France)	I	I		I	
B. diaphanum (France)	I	I		I	
B. garneri (France)	I	I		I	
Fissuria boui (France)	I	I		I	
Hauffenia minuta (Jura)	I	I		I	
Hydrobia scamandri (France)	K	I		I	
Litthabitella elliptica (France)	I	I		I	
Moitessieria juvenisanguis (France)	I	I		I	
M. lineolata (France)	I	I		I	
M. locardi (France)	I	I		I	
M. puteana (France)	I	I		I	
M. rayi (France)	I	I		I	
M. rolandiana (France)	I	I		I	
M. simoniana (Spain, France; M. simoniana lescherae = I)		I		I	
Palacanthilhiopsis vervierii (France)	I	I		I	
Paladilhia pleurotoma (France)	I	I		I	
Paladilhiopis bourguignati (France)	I	I		I	
Plagigeyeria conilis (France)	I	I		I	
Pseudamnicola anteisensis (France)	I	I		I	
P. klemmi (France)	I	I		I	
22 endemic Tenerife gastropods					
Pomatias raricosta	V	V		V	
Napaeus badiosus	V	V		V	
N. nanodes	R	R		R	
N. propinquus	R	R		R	
N. roccellicola	V	E		E	
N. tarnerianus	R	R		R	
N. variatus	V	V		V	
Discus scutula	R	R		R	
Malacolimax wiktori	V	V		V	
Parmacella tenerifensis	V	V		V	
Insulivitrina mascaensis	R	R		R	
I. reticulata	E	E		E	
Canariella fortunata	V	V		V	
C. leprosa	V	V		V	
C. pthonera	V	V		V	

	This Report	IUCN List	Bern Conv.	UNECE List	EEC Hab Direct
Hemicycla adansoni	V	V		V	
H. inutilis	V	V		V	
H. mascaensis	V	E		E	
H. modesta	E	E		E	
H. plicaria	E	E		E	
H. pouchet	V	V		V	
Xerotricha nubivaga	R	R		R	
16 endemic Madeira gastropods					
Leiostyla abbreviata	Ex	V	2	V	2/5
L. cassida	Ex	V	2	V	2/5
L. corneocostata	E	V	2	V	2/5
L. gibba	Ex	V	2	V	2/5
L. lamellosa	Ex	V	2	V	2/5
Discus defloratus	-	V	2	V	2/5
D. guerinianus	Ex	V	2	V	2/5
Caseolus calculus	V	V	2	V	2/5
C. commixta	R	V	2	V	2/5
C. sphaerula	E	V	2	V	2/5
Discula leacockiana	R	V	2	V	2/5
D. tabellata	R	V	2	V	2/5
D. testudinalis	E/Ex	V	2	V	2/5
D. turricula	V	V	2	V	2/5
Geomitra moniziana	R	V	2	V	2/5
Helix subplicata	V	V	2	V	2/5
32 other gastropods					
Platyla foliniana (France)	R	I		I	
Renea bourguignatiana(Fr, Italy)	Ex?	I		I	
Renea gormonti (France)	R	I		I	
R. moutonii (France)	nt	I		I	
R. paillona (France)	R	I		I	
R. singularis (France)	nt	I		I	
Myxas glutinosa (Europe)	V	V		V	
Segmentina nitida (Europe)	S	V		V	
Cryptazeca monodonta (Fr, Spain)	E	I		I	
C. subcylindrica (Fr, Spain)	E	I		I	
Hypnophila remyi (Corsica)	I	I		I	
Chondrina megacheilos caziotana (France)	nt	I		I	
Solatopupa cianensis (France)	nt	I		I	
S. guidoni (Corsica)	I	I		I	
S. psarolena (France, Italy)	E	I		I	
Truncatellina arcyensis (France)	nt	I		I	
Vertigo angustior (Europe)	V	V		V	2?
V. genesii (Europe)	V	V		V	2?
V. geyeri (Europe)	V	V		V	2?
V. moulinsiana (Europe)	V	V		V	2?
Balea perversa (Europe)	K	V		V	
Lamnifera pauli (France, Spain))	R	I		I	
Macrogastra lineolata euzieriana (France)	R	I		I	
Catinella arenaria (Europe)	V	V		V	
Geomalacus maculosus (Ir, Fr,Sp)	V	V	2	V	5/2
Parmacella gervaisi (France)	K	Ex			
Vitrea pseudotrolli (Fr, It)	R	I		I	

	This Report	IUCN List	Bern Conv.	UNECE List	EEC Hab Direct
Cyrnotheba corsica (Corsica)	I	I		I	
Helix pomatia (Europe)	S	R	3	R	6
Macularia saintyvesi (France)	nt	V		V	
Trissexodon constrictus(Fr, Sp)	R	I		I	
Elona quimperiana (Fr, Sp)	R	R	2	R	2/5
5 Unionids					
Microcondylaea compressa (Euro)	V	I	3	I	6
Unio crassus (Europe)	V	V		V	2/5
Unio elongatulus (Europe)	V	I	3	I	6
Margaritifera auricularia (Euro)	E	V	2	E	5
M. margaritifera (Europe)	V	V	3	V	2/6

exotic wildlife, e) designation of protected habitats, f) monitoring of habitat and species change, g) land-use practises, h) incorporation of conservation considerations into economic activities, i) education, training and public awareness, and j) implementation of existing treaties and programmes.

International treaties

As with national legislation, there is a tendency for only the larger and more familiar species to be listed in international treaties, with the result that many highly threatened species have been ignored. At present the molluscs listed on the Bern Convention, and proposed for the EEC Habitats Directive are essential 'flagship' species, listed to illustrate and represent the main problems. There needs to be a better procedure for the listing of molluscs and other invertebrates, to ensure full review of the species concerned by relevant experts. This will be easier if national biological recording and mapping schemes are eventually co-ordinated at the national level.

Bern Convention

The Bern Convention, or Convention on the Conservation of European Wildlife and Natural Habitats, has a specific provision to protect the species listed in its Appendices and their habitats. The molluscs included to date are inevitably only representative. The species were selected to be reasonably recognisable and capable of specific measures to conserve them, and to encourage broader conservation measures for threatened ecosystems.

Appendix II lists 'strictly protected fauna', and prohibits capture, killing, damage to breeding or resting sites, disturbance and trade in these species. Strict habitat protection is therefore required. Appendix III lists 'protected fauna'; these may be exploited unlike Appendix II species but are subject to closed seasons and other means of regulating trade. Out of a total of 81 invertebrates, 19 molluscs are listed on Appendix II and three on Appendix III (Table 3).

It is too early to say whether these listings are having an impact. The Standing Committee to the Bern Committee has set up a group of experts on invertebrates to provide the necessary specialist advice. The European Invertebrate Survey will be concentrating its efforts on the Bern Convention invertebrates, with the aim of documenting status and conservation requirements in greater detail (Speight, 1990). Draft data sheets for M. margaritifera and Geomalacus maculosus have been produced (E.I.S, 1990). The mollusc data sheets in this report are considered a contribution to this project.

Convention on International Trade in Endangered Species of Wild Fauna and Flora - CITES

No European non-marine molluscs are listed in CITES and the majority are not involved in international trade. Both Margaritifera margaritifera and Helix pomatia are exploited and traded domestically and there is a small amount of largely undocumented international trade, but this is probably not significant.

EEC Habitats Directive

This is a proposal for a Council Directive on the protection of natural and semi-natural habitats of wild fauna and flora, aimed at providing legal protection for threatened species within the EEC. It has a specific objective of establishing, by the year 2000, a network of protected wildlife areas for key sites - Special Protection Areas (SPAs) - to ensure the more effective implementation of the Bern Convention within the EEC. The Directive proposes measures to secure the survival of the listed threatened species at SPAs, general protection measures for threatened species outside these key sites and control of exploitation. It also envisages general measures to prevent pollution and degradation of the wider countryside. At present it is in draft form (Hepburn, 1990).

There are several proposed annexes listing threatened species and habitats. Annex 2 covers species for which conservation requires the designation of special protection areas (SPAs). SPAs are not defined, and it is emphasised that they are not necessarily strict sanctuary areas if current land use patterns do not affect the species concerned. Just over 20 non-marine molluscs have been proposed for this annex (Table 3). Annex 5 covers species that need strict protection in the EEC and for which general measures of protection should be established by member states (such as prohibiting deliberate destruction, disturbance etc.) in their territories, not just in special areas. Species on Annex 2 may also be included in Annex 5. About 22 species have been proposed (Table 3). Annex 6 lists species which may be exploited under a management plan, designed to ensure that their exploitation is not detrimental to populations. Four species have been proposed (Table 3).

The main stumbling block with the Directive at present in the lack of financial provision for its implementation. A small sum has been proposed, but this is virtually negligible in the light of the funding provided for development activities through EEC subsidies and other financial incentives (Hepburn, 1990).

Ramsar Convention

Under this convention, contracting parties undertake to protect wetlands, to a depth of six metres, that they have nominated. Most sites to date have been identified on the basis of their importance to birds but there is growing interest in using this convention to help to protect invertebrates (Council of Europe, 1991). So far no sites have been specifically looked at in the context of molluscs but some consideration should be given to this.

Captive breeding, translocation and farming

Captive breeding is increasingly used as a technique for increasing populations of highly threatened species, and it being used with some success for a number of species, notably the Partula of Moorea (Murray et al., 1988). However, it should not detract from the importance of protecting species in the wild. At present there are few if any European species sufficiently endangered to warrant captive breeding programmes.

However, research is now being carried out on ways of increasing populations of unionids, and there may be potential for some form of captive breeding or rearing. This would then permit restocking of depleted rivers. Some efforts have also been made to translocate populations to less threatened habitat and this can be successful under appropriate conditions. It has also been used for the Hungarian endemic gastropod Sadleriana pannonica and might have potential for some other narrowly endemic snails.

Farming of economically important wild species can on the other hand take pressure of exploited populations. Snail farming has flourished over the last decade. Helix aspersa is now raised commercially in farms in a number of countries including France, UK and Italy. The snails reproduce and the early juveniles stages are kept in a nursery under controlled conditions, and then put outside in large enclosures for rearing to commercially valuable sizes over the summer (Daguzan, 1986; Elmslie, 1986a). Helix pomatia is being increasingly farmed and trials are under with with other species such as Helix lucorum. The market for snails is thought to be capable of expansion (Elmslie, 1986b), although the extent to which this will diminish exploitation of wild Helix pomatia remains to be seen.

Table 4. National legislation relating to molluscs

Only legislation specifically naming mollusc species is listed; many molluscs occur within protected areas and are protected under legislation covering these sites; general wildlife and welfare legislation may also at times be relevant.

Austria collecting of Helix pomatia controlled.

Belgium Collection of H. pomatia and H. aspersa controlled since 1984.

Bulgaria collection of H. pomatia controlled.

Czechoslovakia M. margaritifera protected.

Denmark Commercial collection of Helix pomatia prohibited September 1990; Margaritifera margaritifera full protection.

Finland Full protection of M. margaritifera since 1955.

France Full protection for M. margaritifera, Helix melanostoma, H. aperta, H. ceratina, Tacheocampylaea raspaili, Macularia niciensis, Otala punctata, Elona quimeriana, Rumina decollata under ministerial decree of 1979; collection of H. pomatia, H. aspersa and Zonites algirus controlled under ministerial decree of 1979.

Germany collection of H. pomatia and M. margaritifera controlled; H. aspersa, Anodonta anatina, A. cygnea, Pseudanodonta complanata, P. elongata, P. middendorffi, U. crassus, U. pictorum, U. tumidus.

Gibraltar Trade in Acicula norrisi, Cecilioides spp., and Osteophora calpeana controlled under Endangered Species (Import & Export) Ordinance 1990. These species also to be protected under Wildlife Ordinance of 1991.

Great Britain Collection, possession and sale of Myxas glutinosa and Catinella arenaria prohibited under 1981 Wildlife and Countryside Act; Margaritifera margaritifera also protected, although collection allowed under special circumstances.

Greece Helix godetiana protected.

Hungary Full protection for Theodoxus prevostianus, Pomatias elegans, Sadleriana pannonica and Bielzia coerulans.

Ireland: Geomalacus maculosus and Margaritifera margaritifera protected.

Italy collection of H. pomatia controlled.

Luxembourg collection of H. pomatia controlled.

Netherlands collection of H. pomatia controlled.

Poland collection of H. pomatia controlled and M. margaritifera protected until 1982 when declared extinct.

Sweden M. margaritifera protected.

Switzerland collection of H. pomatia controlled.

RECOMMENDATIONS

Protection of species

In addition to those species already in the IUCN Red List and on international treaties and lists (see Table 3), the following species have been identified in this report as of conservation concern:

a. National and island endemics in Austria, Azores, Corsica, Czechoslovakia, Germany, Gibraltar, Hungary, Italy, Poland, Portugal, Romania, Switzerland, Tenerife, and additional species in Madeira (see listing of single country endemics and relevant country data sheets).

b. Species endemic to particular regions such as the Danube snails (see section on 'near' endemics).

c. A number of widespread but apparently declining species: Valvata macrostoma, V. pulchella, Anisus vorticulus, Gyraulus laevis, Lymnaea glabra, Cochlicopa nitens, Vallonia declivis, V. enniensis, Pseudanodonta complanata, Pisidium pseudosphaerium, P. tenuilineatum, Sphaerium rivicola and S. solidum.

These species should be considered for listing at the national, regional or international level as appropriate and if necessary protected areas for them should be identified. Existing protected areas should be surveyed for molluscs in order to determine those species that at present receive no habitat protection. Key sites for narrow endemics should be identified and protected (e.g. Pezzoli (1988a,b,c) has identified springs and underground water systems in northern Italy that need protecting for their hydrobiid faunas).

Development of recovery plans

These need not necessarily be costly. High priorities are sympathetic management of hedgerows, roadside verges, ponds, woodland and even marginal habitat such as golf courses and military land. If carried out on a large scale this may achieve more or as much as the creation of protected areas.

Implementation of conventions and agreements

UNECE Red List: Draft recommendations have been prepared for the application of the UNECE Red List of Threatened European Species and once passed these should be implemented. They concern 1) application of the Red List when formulating conservation policies and strategies; 2) implementation of protective measures or monitoring depending on the degree of threat in the country of concern; 3) compilation or updating national Red Data Books; 4) strengthening national programmes for surveying fauna and flora and their habitats; 5) re-introducing species as appropriate; 6) carrying out captive breeding, restocking and translocation projects; 7) participatione in existing wildlife conventions; 8) send information to international databases such as the World Conservation Monitoring Centre.

Bern Convention: the three unionids on Appendix 3 should also be listed on Appendix 2 for protection of their habitat. Unio crassus and possibly some other species should be added to Appendix 2. The list of Madeiran endemic snails on Appendix 2 needs revision in the light of recent taxonomic work and the identification of additional threatened

species. Threatened endemics of other countries and some of the widespread but declining molluscs, particularly wetland species, should be considered for inclusion. Recommendations specifically for wetland species are given in Council of Europe (1991). A general recommendation for unionids has also been put forward to the Council of Europe (see data sheet on Margaritifera margaritifera).

Ramsar Convention: recommendations for wetland invertebrates are given in Council of Europe (1991).

EEC Habitats Directive: the draft annexes need revision for the mollusc species listed. Details are not provided here as the annex have been undergoing recent revision and some changes may already have been made.

Many of the general recommendations for invertebrate conservation e.g. Council of Europe (1987), Collins and Wells (1987) are important for molluscs, such as increasing basic research on taxonomy and population biology, continuing mapping and biological recording programmes and co-ordinating such activities at the regional level.

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